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THE OPERATIONS OF SURGERY

THE

OPERATIONS OF SURGERY

INTENDED ESPECIALLY FOR THE USE OF
THOSE RECENTLY APPOINTED
ON A HOSPITAL STAFF
AND FOR
THOSE PREPARING FOR THE HIGHER EXAMINATIONS

BY
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PART IV.

THE ABDOMEN.

CHAPTER I.

LIGATURE OF VESSELS.

EXTERNAL ILIAC. COMMON ILIAC. INTERNAL ILIAC. GLUTEAL. SCIATIC. ABDOMINAL AORTA.

LIGATURE OF THE EXTERNAL ILIAC (Figs. 1, 2, and 3).

Indications.—Chiefly:

1. Some cases of aneurysm of the upper part of the femoral, or of the femoral encroaching on the external iliac itself.—Mr. Holmes (R.C.S. Lect., *Lancet*, 1873, vol. i.) shows that in ilio-femoral aneurysms it is often very difficult to say whether the aneurysm is or is not limited to the iliac or femoral—*i.e.*, whether it is wholly above or below the place where the deep epigastric and circumflex iliac come off, or whether the mouths of these vessels open out of the sac. In the former case the aneurysm would be purely iliac or femoral; in the latter, ilio-femoral. Thus, ligature of this vessel is indicated where pressure, rapid or gradual, has failed to command the circulation, where it is intolerable, where it cannot be made use of owing to the abundance of fat, from failure of pulse and breathing under an anæsthetic, or from the height at which the aneurysm involves the external iliac (it being increasingly difficult to apply pressure in these cases without dangerous interference with the peritonæum and its contents), where the patient from chronic bronchitis is quite unfit for a prolonged trial of continuous pressure under an anæsthetic, or in cases where the increase of the aneurysm is very rapid.

Before deciding on relinquishing the idea of pressure for ligature, the surgeon should refer to a paper by Mr. Wheelhouse (*Clin. Soc. Trans.*, vol. vii. p. 57). This case is one of the most interesting in all surgery.

The patient, a publican, and syphilitic, had previously been cured by Mr. Wheelhouse of a right-sided popliteal aneurysm,* by means of continuous pressure for eight h with a Porter's femoral-compressor. A few months later he was admitted into Leeds Infirmary with a large right iliac aneurysm,† reaching from Poupart's ligai to within two inches of the umbilicus, and extending outwards almost to the spii the ilium. The swelling, about the size of a small cocoa-nut, was hard and firm b soft above; it appeared to be wholly connected with the external iliac, but to ex above and overlie the common iliac. Pressure could not be made on the latter v sufficient to stop the beating, as the tumour was too much in the way, but it was e controlled by pressure on the abdominal aorta. The patient was kept under the influ of ether for five hours, Lister's tourniquet being very slowly screwed down just ove umbilicus. By the end of the time the patient was black in both limbs, and blue a as the tourniquet. This had been slightly relaxed twice. No other unpleasant symp arose during the whole time. A quarter of an hour was taken in relaxing the pre —a quarter turn of the handle being made every minute. The tumour had cease pulsate, and was firm and hard. Pulsation gradually recurred with nearly its old f but was less "distensile," and slowly ceased altogether, an excellent recovery b made.‡

In ruptured femoral aneurysm the old operation (facilitated by application of a tourniquet above) would usually be indicated, but Southam (*Brit. Med. Journ.*, 1883, vol. i. p. 818) has briefly reporte case in which he tied the external iliac successfully in a patient wh femoral aneurysm suddenly ruptured and became diffuse. The effu blood was quickly absorbed, and there was never any tendency to gangrene. Complete power over the limb was regained.

---

* It is very possible that the strain thrown on the artery above during the treatn by pressure on the femoral was the cause of the aneurysm higher up. The liabilit patients with one aneurysm to develop another may often baffle the surgeon. Clutton (*Brit. Med. Journ.*, 1880, vol. i. p. 441) records a case in which a fem aneurysm was cured by the use of Esmarch's bandage applied up to the tumour, an Pétit's tourniquet adjusted over the brim of the pelvis. The first attempt lasted hour; at the second trial the bandage was removed in an hour, and the tourniquet tinued for nine hours, anæsthetics not being given. The aneurysm ceased to pul and began to shrink, but still fluctuated. Nine days after leaving the hospital, patient died suddenly of an aortic aneurysm rupturing into the pericardium.

† Dr. Diver, of Southsea, has put on record a case in which the external iliac was in a case in which a popliteal and an inguinal aneurysm co-existed on the right s Gangrene followed, a line of demarcation forming in the lower third of the Amputation through the thigh was performed, and the patient recovered. A sim case of double aneurysm is reported by Mr. Hilton (*Med.-Chir. Trans.*, vol. lii. p. 3 A tourniquet was first applied to the right common iliac for six hours without effect the aneurysms. A second trial of pressure was made later on, with a tourniq again on the common iliac and one on the femoral at the apex of Scarpa's trian In about nine hours both aneurysms were cured. Chloroform was used on b occasions.

‡ Cases of Dr. Mapother's and Mr. Holden's, in which ilio-femoral aneurysms w cured by pressure on the common iliac and the aorta, will be found recorded by Mapother in the *Dub. Med. Press*, March 29, 1865; and by Mr. Holden in *St. Bart Hosp. Rep.*, vol. ii. p. 190; *Syd. Soc. Bien. Retr.*, 1865-6, pp. 306, 307. In Dr. Mapoth case, instrumental pressure on the right common iliac (about an inch below and h an inch to the right side of the umbilicus), kept up for twelve hours under chlorofo had failed. A second attempt, with a Signorini's tourniquet on the end of the abdomi aorta, and a Skey's tourniquet on the femoral just as it left the sac, pressure being k up for four hours and a half, made the tumour solid and pulseless. Two rigors follow and a carbuncle formed at the site of the first compression. In Mr. Holden's pati the aneurysm was also large, and double aortic valvular disease was present. Chlorofo was given here continuously for an hour and a half, and then with cautious interm sions, owing to the state of the pulse and breathing, for the rest of the treatment, wh lasted four hours.

2. Wounds.—A wound of the external iliac is so rare as to be almost unknown.* It has been frequently tied for hæmorrhage from parts below—*e.g.*, for secondary hæmorrhage after wounds of the femoral high up, after ligature of the femoral, and after amputation at or near the hip. The futility† of this treatment is thus shown:

Dr. Otis (*Med. and Surg. History of the War of the Rebellion*, pt. iii. p. 788) gives a summary of twenty-six cases in which the external iliac was tied for such cases as the above. Of these, twenty-three ended fatally, a mortality of 88·4 per cent. The uselessness of trusting to ligature of the external iliac in such cases, instead of either securing the wounded vessel itself, or trusting to well-applied pressure, was long before this insisted on by Guthrie.‡ This question is alluded to again below, but in proof of the above statement a case may be mentioned here, in which hæmorrhage returned after ligature of the external iliac, and was arrested by well-applied pressure. The patient had been wounded, January 15, 1865, by a minié ball, entering at the upper and inner part of the thigh, and emerging near the knee. The wound becoming sloughy, hæmorrhage occurred (March 23 and 31), and the external iliac was tied. April 21, hæmorrhage recurred from the upper gunshot wound, and was successfully restrained by a horseshoe tourniquet, constantly kept on for two weeks, when it was omitted, without any subsequent hæmorrhage. The wounds were now healing kindly, when (May 31) dysentery set in, carrying off the patient, June 15, two and a half months after the operation of ligature.

3. Elephantiasis.—Ligature of the external iliac or femoral (when the condition of the soft parts admits of it) has been extolled by some surgeons in the treatment of this affection.§ A larger experience shows, however, that when cases thus treated are watched, the cures cannot be

---

* The only case with which I am acquainted is one quoted by Mr. Erichsen from Velpeau (*Nouv. Elém. de Méd. Opér.*, t. i. p. 175), in which the above French surgeon was suddenly called upon to tie the external iliac for a knife-wound. Though there had been no preliminary dilatation of the collateral circulation either by pressure or by the presence of an aneurysm, the result was successful.

† It is fair to state that Mr. Bartleet, of Birmingham, published a case in which the external iliac was tied successfully after secondary hæmorrhage from the common femoral, the latter having been tied for aneurysm of the femoral artery. Previous to ligature of the external iliac, "sponge-pressure" and pressure by means of a Martin's bandage were tried, but no details are given. It is noteworthy that the catgut ligature applied to the femoral in this case came away on the seventh day (the first day of the hæmorrhage) unobserved, and surrounding a small slough of the artery. It had been tied "tightly."

‡ *Wounds and Injuries of the Arteries*, Lects. v. and vi.

§ An apparently successful case is reported by Mr. Leonard, of Bristol. Measurements are given nearly three years after the operation, showing that the success was then maintained. Five years later the patient reported that "his leg was much the same" as at the last report. Bandaging does not appear to have been made use of here. Prof. Buchanan (*Brit. Med. Journ.*, Nov. 23, 1867; *Syd. Soc. Bien. Retr.*, 1867-8, p. 300) reports a case, seven months after the operation, apparently cured by ligature of the external iliac, after failure of rest and methodical compression (this was before the introduction of Martin's bandage). Three months later it is candidly stated that the disease had recurred to a considerable degree. Dr. White, of Harvard University (*Internat. Encycl. of Surg.*, vol. ii. p. 631), quotes Wernher (reference not given) as having followed up thirty-two cases; in all there was an immediate reduction of size, but the relief was permanent in three only. Dr. Pinnock, of Melbourne (*Lancet*, 1879, vol. i. p. 44), gives a case in which no permanent benefit followed on ligature of the femoral artery.

relied upon as permanent. Moreover, too little value has been attached, in reported cures by ligature of the main vessel, to the thorough rest and elevated position entailed by tying the artery.

This operation should, I think, be reserved for those cases (which will be very few) in which Martin's bandages cannot be applied, owing to cracks, foul ulcers, or burrowing sinuses. Here the ligature may be used after explaining its risks to the patient, but only as a subsidiary measure. The bandage will have to be used as well later, and persisted in, during the day at least, probably for life.

4. As a distal operation in aneurysm of the common iliac.—Ligature of the external iliac has been so unsuccessful here as to call for no further comment.

Surgical Anatomy.

EXTENT.—From the lumbo-sacral articulation to a point just internal to the centre of Poupart's ligament. LENGTH—3½ to 4 inches.

SURFACE MARKING.—From a point an inch below and to the left of the umbilicus to a point just internal to the centre of Poupart's ligament.

RELATIONS:— IN FRONT.

Peritonæum, small intestines.
Iliac fascia.
Lymphatic glands and vessels.
Genito-crural nerve (genital branch).
Spermatic vessels } Crossing artery near Poupart's
Circumflex iliac vein } ligament.

OUTER SIDE.		INNER SIDE.
Psoas (above). Iliac fascia.	External iliac artery.	Iliac fascia. Vein.

BEHIND.

Iliac fascia.
Vein (above).
Psoas (below).

Vas deferens (dipping from internal ring to pelvis).

Collateral Circulation.

Deep epigastric	with	Internal mammary, lower intercostals, and lumbar.
Deep circumflex iliac	,,	Ilio-lumbar, lumbar, and gluteal.
Gluteal and sciatic	,,	Internal and external circumflex.
Comes nervi ischiadici	,,	Perforating branches of profunda.
Obturator	,,	Circumflex arteries and epigastric.
Internal pudic	,,	External pudic.

Operation.—(1) By the lower and more transverse incision of Sir A. Cooper. (2) By the higher and more vertical incision of Abernethy. The two are compared at p. 7. (3) By the intra-peritonæal method (p. 22).

(1) INCISION OF SIR A. COOPER.—This is the method more frequently made use of. The diet having been limited, and the bowels having been freely moved for some days before the operation, the parts shaved, and the hip slightly* flexed, an incision is made 4 inches long (4½ to 5, if there be very much fat, or if the parts are pushed up by a contiguous aneurysm), parallel with Poupart's ligament, and nearly an inch above it, commencing just outside the centre of the ligament and extending outwards and upwards beyond the anterior superior spine.† The superficial fascia and fat, varying in amount, being divided, and the superficial circumflex iliac vessels secured, the external oblique, both fleshy and aponeurotic, is cut through, and then the fleshy fibres of the internal oblique and transversalis. This is done either by using the knife alone, lightly and carefully, or by taking up each layer with forceps, nicking it, and slitting it up on a director. If the wound be sponged carefully,‡ a layer of cellular tissue can usually be seen between the muscles, however thin they are. Any muscular branches should be secured with Spencer Wells's forceps as soon as cut; and in pushing a director beneath the muscles as little damage as possible should be done, owing to the proneness to cellulitis later on, and to the proximity, in a thin patient, of the peritonæum. The fascia transversalis, when exposed, will be found to vary a good deal in thickness and in the amount of fat which it contains. It is to be divided very carefully,§ and the extra-peritonæal fat, if present, will next come into view. First one and then two fingers being introduced, the peritonæum is to be gently stripped up from the iliac fossa towards the middle line—*i.e.*, upwards and inwards as far as the inner border of the psoas.‖ In doing this care must be taken, especially in the dead body, not to separate the iliac fascia and the vessels from their position on the psoas, not to tear this muscle, and not to lacerate

---

* So that the skin may not be too much relaxed before being incised. Later on, to relax the parts, the hips may be more strongly flexed.

† The incision may have to be made higher than usual, owing to the upward extension of the aneurysm, to enable the surgeon to tie either the upper part of the external or the common iliac. On this point see the remarks on the comparison of Cooper's and Abernethy's operations, p. 7. Often in these cases of upward extension of the aneurysm the sac is found to involve the lower part of the artery, and to have overlapped the upper portion.

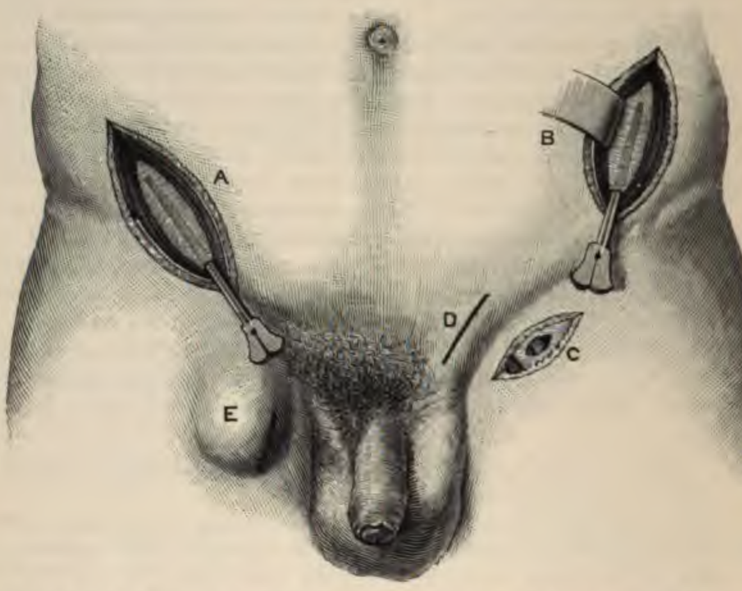
‡ In some cases where the circulation has been much interfered with by an aneurysm, most copious hæmorrhage, especially venous, has been met with in the earlier steps of this operation.

§ Dr. Sheen (*Brit. Med. Journ.*, 1882, vol. ii. p. 720) thus writes of the accident which may happen here: "I made the incision somewhat too high, and, in consequence, opened the peritonæum, which I mistook for transversalis fascia. Even then I was in a little doubt, because some (omental) fat presented itself, which very much resembled the fat seen in the previous case (fat around the vessel), but, in pushing this up gently, a knuckle of bowel came into view, which settled the matter." The wound in the peritonæum was sewn up with two fine carbolised sutures, and the case did perfectly well.

‖ Great care is needed here if the peritonæum be adherent. This condition, when present, is usually found above. It is especially likely in long-standing cases, and where the aneurysm has caused irritative and inflammatory changes. By some it is held that the transversalis fascia can always be stripped up along with the peritonæum. As this fascia is thickened and attached, close to Poupart's ligament, to form the deeper crural arch and front of the femoral sheath, it is very doubtful if it can ever be detached unless it be divided or torn through. The latter is very easy on an aged corpse.

the peritonæum. As soon as the peritonæum has been well raised, assistant keeps this and the upper lip of the wound well out of the w by means of broad retractors. The surgeon then feels for the pulsat of the artery on the inner border of the psoas, and carefully opens layer of fascia which ties the vessel to the psoas, and forms a we sheath to it. This should be done 1¼ inch above Poupart's ligame so as to lie well above the origin of the deep epigastric, which usua comes off ¼ or ½ inch above Poupart's ligament, and the needle pas from within outwards, carefully avoiding the vein on the inner side a the genito-crural nerve outside and in front. In difficult cases the ligature (of sterilised silk, or kangaroo-tail) must mainly be passed by touc but a free incision, adequate use of retractors, and light thrown in by large mirror will usually allow the surgeon to see what he is doing. Th effect of tightening the ligature being satisfactory, it is cut short an dropped in, the divided muscles are then brought together with burie gut sutures, sufficient drainage provided, and the superficial woun closed. The parts must be kept relaxed by propping the chest up slightl and flexing the knees over a pillow, but too much flexion of the groin to be deprecated as causing a deep sulcus from which possible discharge may escape with difficulty. The limb is evenly bandaged from the toe upwards, raised, and kept covered in cotton-wool, with hot bottles place in the bed.* In case of threatening gangrene, assistants should persever

FIG. 1.



To show the incisions for—A, Ligature of the external iliac artery. B, Ligature of the common iliac artery. C, Ligature of the common femoral artery. D, Strangulated inguinal hernia. E, Strangulated femoral hernia. (Heath.)

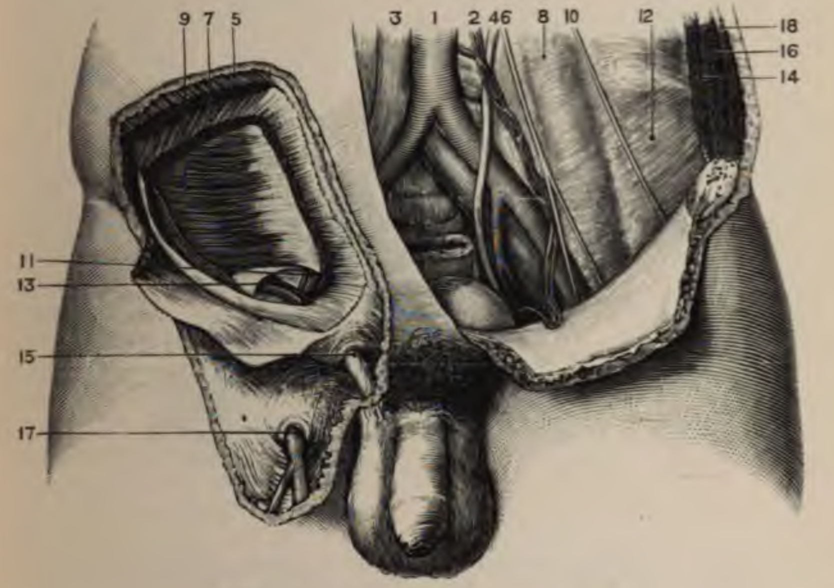
---

* If the patient be restless, as in delirium tremens, a long splint should be applied.

in a trial of friction of the limb from below upwards. Where there is a history of syphilis, appropriate remedies should be given after the operation.

(2) INCISION OF ABERNETHY.—In his first operation this surgeon made his incision in the line of the artery for about 3 inches, commencing nearly 4 inches above Poupart's ligament. Later on he modified his incision by making it less vertical and more curved, with its convexity downwards and outwards, and extending between the following points—viz., one about 1 inch internal and 1 inch above the anterior superior spine to 1½ inch above and external to the centre of Poupart's ligament.

FIG. 2.



Anatomy of the iliac arteries and hernia.

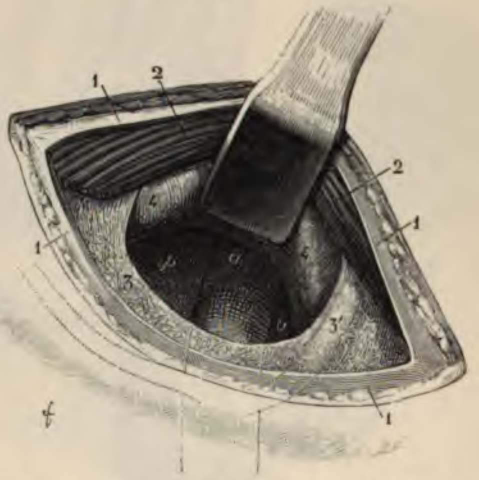
1. Abdominal aorta.
2. Spermatic vessels.
3. Inferior vena cava.
4. Ureter.
5. Obliquus externus.
6. Genito-crural nerve.
7. Obliquus internus.
8. Psoas fascia.
9. Transversalis.
10. External cutaneous nerve.
11. Epigastric vessels.
12. Iliac fascia.
13. Spermatic cord.
14. Section of transversalis.
15. External abdominal ring.
16. Section of obliquus internus.
17. Saphenous opening.
18. Section of obliquus externus.

The respective **advantages** and **disadvantages** of the methods of Cooper and Abernethy appear to be the following: Cooper's is rather the easier, interfering, as it does, with the peritonæum less and lower down. It is most suitable to those cases which do not extend far, if at all, above Poupart's ligament. On the other hand, where the extent to which the aneurysm reaches upwards is not exactly known, Abernethy's operation, hitting off the artery, as it does, higher up, or some modification of that given (p. 16) for ligature of the common iliac, will be found preferable.

Difficulties and Possible Mistakes.

(1) Too short an incision. Here, as in colotomy and other dee operations on the abdominal wall, every layer must be cut to the fu extent of the superficial ones. Otherwise the operator will be workin at the bottom of a conical, confined wound. (2) A wrongly place incision—*i.e.*, one which, by going too near the middle line, opens th internal abdominal ring, or which, if too low, may come too near th cord. (3) Disturbing the planes of cellular tissue needlessly or roughl (4) Wounding the peritonæum, owing to a hasty incision through thin abdominal wall, by rough use of a director, especially if the peri tonæum is adherent in the neighbourhood of the sac, or fused with th transversalis fascia. The peritonæum is often difficult to distinguish; i

FIG. 3.



Ligature of the right external iliac artery. 1, External oblique aponeurosis. 2, Fleshy fibres of internal oblique and transversalis. 3, Transversalis fascia. 4, Peritonæum (drawn up by the retractor). *a*, Artery. *v*, Vein. *p*, Psoas muscle. (Farabeuf.)

is bluish in aspect, but of course not smooth, being covered with cellular tissue which connects it to the extra-peritonæal fat. (5) Stripping up the peritonæum roughly and too far. (6) Detaching the artery from the psoas. (7) Lacerating the psoas. (8) Tying or injuring the vein. (9) Including the genito-crural nerve. (10) An abnormal position of the artery. This may be due to an exaggeration of that naturally tortuous condition of the artery which is especially likely to be met with in patients advanced in life. Another unusual cause of displacement may be met with in extravasated blood when an aneurysm has given way.

Sir W. Fergusson briefly reported (*Brit. Med. Journ.*, 1873, vol. i. p. 286) an instance of this kind, in which the sac gave way after repeated manipulation.

Causes of Failure and Death.

1. Gangrene.—In some cases, where the limb does not become gangrenous, the vitality is very feeble and requires much attention.

Thus, in Mr. Rivington's case (*Clin. Soc. Trans.*, vol. xix. p. 45), loss of sensation was noticed on the fourth day, followed by paralysis of most of the muscles. Though gangrene did not appear, and the patient survived five and a half months, the limb was "on the verge of gangrene," as shown by sores appearing on the heel and great toe.*

2. Secondary hæmorrhage.—This is especially likely if the wound becomes septic and if catgut is used. This fatal result may be long deferred.

Thus, in Mr. Rivington's case (*loc. supra cit.*), the patient died of secondary hæmorrhage five and a half months after the operation; the wound had been found septic at the first dressing; a catgut ligature was used.

Early recurrence of pulsation may be ominous of secondary hæmorrhage.

In a case of Sir A. Cooper, the hæmorrhage which proved fatal a fortnight after the operation was found to be due to a large collateral—viz., an abnormal obturator arising immediately above the site of ligature (Roux, *Parallèle de la Chir. anglaise avec la Chir. française, &c.*, pp. 278, 279).

3. Cellulitis. Septicæmia. Pyæmia.—Owing to the number of planes of cellular tissue met with here, any needless or rough disturbance of the parts, inadequate drainage, or a septic condition supervening are extremely to be deprecated. The wound should be opened up at once if any collection of fluid is suspected. 4. Peritonitis. 5. Tetanus, from including the genito-crural nerve. 6. Phlebitis and secondary hæmorrhage from injury to the external iliac vein. 7. Suppuration of the sac with its attendant dangers of septic infection and secondary hæmorrhage.†—This accident is far from uncommon in cases of inguinal aneurysm after ligature. No pains should be spared to prevent its occurrence by taking every step to keep the wound strictly aseptic from first to last, and thus to secure early and sound healing. Absolute rest should also be enforced upon the patient. If suppuration take place it will usually be within two months of the date of ligature. The symptoms need not be alluded to here beyond pointing out that pulsation is one of very grave omen. When it is evident that suppuration, if not established, is inevitable, the surgeon should so arrange his time as to choose a suitable occasion, both as to assistance and a good light, for interfering. Allowing the suppurating sac to open spontaneously should not be thought of, not only because of the risk of hæmorrhage, the want of preparation, &c., but because septic infection is now made very probable. The operative steps are much the same as in the old operation for aneurysm, for which the reader is referred to p. 27. It may be here pointed out that in this case there is more chance of the hæmorrhage taking the form of a general oozing from the sac, and not that of a gush or spirt of blood. Moreover, if the collateral circulation has been well established, there is also the probability of the sac being fed by some additional branch, which, perhaps, entering deep down, may be a cause of much embarrassment. 8. Recurrence of

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* In one of Dr. Sheen's cases already referred to, four days after the operation a large patch of skin on the outer side of the thigh was noticed to be darkish in colour, and to pit on pressure, though normal as to sensation. The case did quite well.

† Very occasionally secondary hæmorrhage may take place to a slight amount, and leave off spontaneously. Thus, in one of Dr. Sheen's cases, five weeks after the operation "about an ounce of bright-red blood came from the slight remaining wound, and a slight oozing again after a few days, but there was no further hæmorrhage."

pulsation.—This is especially likely to occur when a catgut ligature ha been used and given way, owing to its being softened by suppuratio Over-free collateral circulation will cause recurrence of pulsation quickly and melting down of soft coagulum (this appearing to be all that th blood can do in the way of clotting) will bring about the same cause failure later on. In these cases the following courses are open in th matter of the external iliac—viz., well-adjusted and carefully-maintaine pressure, and the old operation. Ligature of the vessel lower down—i.e between the first ligature and the aneurysm—and amputation are no available here.* Two other conditions which may supervene and prov troublesome should be mentioned here—viz.: 9. Formation of a ventra hernia.—This should be prevented as far as possible by ensuring primar union, and by the use of deep chromic-gut sutures in the cut muscles Later on, if this complication threaten, an appropriate belt shoul be worn. 10. Coming away of the ligature long after the operatio through a persistent sinus or re-opened wound.—This may happe even in a wound kept sweet from first to last, if a silk ligature ha not been properly sterilised, or if one of too close texture is use See footnote, p. 552, vol. i.

LIGATURE OF THE COMMON ILIAC (Figs. 4 and 5).

Indications.—Very few:

1. Aneurysms.—Especially those inguinal aneurysms which affect th external iliac in its upper part, above the origin of the deep epigastric occupying the iliac fossa and lower part of the abdomen. When suc aneurysms are progressing steadily, when they have resisted a trial o pressure, and are not thought amenable to the old operation, ligature o the common iliac is indicated.

The following remarks by one of the chief living authorities o aneurysm, Mr. Holmes (R.C.S. Lectures, *Lancet*, 1873, vol. i. p. 297) will aid the surgeon in coming to a decision in this most important matter:

> "Allowing that an iliac aneurysm is amenable to all three methods of treatment—the Hunterian, by ligature of the aorta or common iliac; the old operation, by laying open the sac and securing the artery or arteries opening into and out of it; and the method of compression applied to the aorta or common iliac,—I think no one could deny that the number of cures by the latter method bears a very large proportion to the number of cases treated, while the cures by the Hunterian method are very rare, and the other method is as yet pretty nearly untried.
>
> "But this is far from settling the question; compression, doubtless, often succeeds but it also often fails. It is not without its risks. It usually requires the prolonged use of chloroform, and this cannot always be borne by the patient.
>
> "The question of applying the old method in preference to the Hunterian in those

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* In one case (*Syd. Soc. Bien. Retr.*, 1873-4, p. 220), after ligature of the external iliac for a femoral aneurysm with catgut, and premature absorption of this on the fifth day (the wound suppurated freely, and antiseptic precautions do not appear to have been taken), pulsation returned, and the swelling enlarged. The patient was operated upon again, and a stout carbolised hempen ligature made use of, one end being left long. Though, owing to the close matting of parts, the peritonæum was wounded twice, and intestines and omentum protruded, the patient recovered.

cases (rare, it may be, but which must sometimes be met with) in which pressure has failed, is one which Mr. Syme's brilliant operations have put in a totally new light. And I must say, for my own part, that, looking at the awful mortality which has attended the ligature of the common iliac for aneurysm, and the uniform fatality of the same operation on the aorta, I think Mr. Syme's suggestion ought to be put to the test of more extended experience, although the facts and reasonings which I have adduced will show that I am not insensible to the risks which attend the performance of the operation, to the probability of secondary hæmorrhage, and to the extensive injury which must be inflicted upon parts in the immediate neighbourhood of important organs."

Mr. Holmes then, in proof of the great fatality of the Hunterian operation on the common iliac, quotes the list collected by Dr. Stephen Smith (*Amer. Journ. Med. Sci.*, July 1860, vol. xl.), in which, out of fifteen cases in which that vessel was tied for aneurysm, only three can be reckoned as definitely cured.

Mr. Holmes's belief that subsequent experience has not been more favourable is supported by a table of 65 cases, tabulated by Dr. Packard.* Of these 65 cases, no fewer than 51 died, only 14 recovering, giving a general mortality of 78·46 per cent.†

Mr. Holmes goes on to discuss the old operation, and, in answer to the objection that, though the Hunterian operation has been attended with "awful mortality" here, we are not made more secure by operating on an artery, perhaps not much more than three inches lower down, and already involved in disease, writes: "I reply that if we grant the artery where it is involved in the sac to be healthy enough to bear the ligature, many advantages may be found in the old operation over that of Hunter. . . . First, the clot is removed and the sac laid open; consequently, that softening of clot and inflammation of a closed sac lying in proximity to the peritonæum, which is so surely fatal, is obviated. Next, the ligature will probably be placed on the external iliac instead of the common, and thus the chances of gangrene will be greatly diminished, since the internal iliac and its branches are left open. Thirdly, the artery is tied at a point where most likely the peritonæum and viscera have been pushed away from it by the sac, so that there is less risk of hurtful interference with these latter in the operation. And, lastly, the total excision of the tumour precludes any such relapse as occurs sometimes after the Hunterian operation.

"Against these advantages must be set the undoubted risks of secondary hæmorrhage, even in cases where the immediate dangers of the operation have been surmounted. What this risk is we have no means of judging until our experience of this operation becomes greater; but I am under the impression that Mr. Syme much underrated it, in consequence of having operated chiefly upon traumatic aneurysm."

Farther on, Mr. Holmes writes, while "maintaining that the old doctrine on which the superiority of Hunter's operation is based is quite true in general, I should have no objection in the particular instance of iliac aneurysm to follow Mr. Syme's practice; at least, until further experience of it should show that it is wrong: only the less dangerous expedient of rapid compression of the trunk artery under chloroform, or gradual compression, with or without chloroform, should first be tried."

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* *Trans. Amer. Surg. Assoc.*, vol. i. p. 234. Sixty-seven cases are given, but the result is not stated in two.

† Grouping these cases into classes, after Dr. Smith's example, in order to obtain more satisfactory deductions, Dr. Packard concludes as follows:—(i.) Those cases in which the operation was done for the arrest of hæmorrhage: 22 cases, of which 19 died and 3 recovered; mortality, 86·36 per cent. (ii.) Those in which it was done for the cure of aneurysm: 35 cases, of which 24 died and 9 recovered, the result not being stated in 2; mortality in 33 cases, 72·72 per cent. (iii.) Those cases in which tumours simulating aneurysm led to its performance: 5 cases, 4 of which died and 1 recovered (iv.) Those in which the vessel was secured to prevent hæmorrhage during the removal of a morbid growth: 5 cases, all of which died.

The same authority, when, later on, discussing the value of pressu brings out the following facts. That, while rapid compression und chloroform is a mode of treatment by which most gratifying success h been obtained in iliac as well as aortic aneurysm, it exposes the patie to serious dangers. Amongst these are enteritis and peritonitis fro bruising of small intestine, mesentery, meso-colon, and sympatheti hæmaturia; failure of pulse and breathing when the pad is screw down. On account of these very real dangers, which every dexteri may not obviate, Mr. Holmes advocates a trial of gradual compressio as safer though less efficient, and he points out that the relations of t common iliac are less complicated than those of the aorta, and "as w get further to one side, there is more chance for the intestines to slip o of the way."*

2. Wounds.—These may be gunshot or bayonet wounds, or knif stabs of the vessel itself, or the internal iliac or its branches, usually t latter. The hæmorrhage calling for ligature seems to be usual secondary.† Gunshot wounds of the common iliac have a fresh intere now, owing to the recent advances in surgery in the treatment of gunsh wounds of the abdomen.

Dr. S. Smith‡ gives two cases of ligature of the common iliac f wounds:

One was from a musket-ball which injured the vessel itself, passed through t intestines, and lodged in the sacrum. The operation was performed by opening t peritonæal cavity. Peritonitis soon set in; secondary hæmorrhage recurred repeated and the case ended fatally on the fifteenth day. The other case is of great interest, the common and internal iliac were here tied for severe hæmorrhage after a stab in t inguinal region. A large quantity of blood was found in the peritonæal cavity, and t patient died ten hours after the operation. At the necropsy it was found that the de epigastric was the wounded vessel.

Dr. Otis§ records four cases of ligature of the common iliac durin the American Civil War:

In one, a gunshot wound, in which the ball entered the groin and came out at t buttock, the external iliac was first tied, the repeated hæmorrhages being believed to from the profunda; but as the bleeding persisted and evidently came from the sciati the wound was prolonged and the common iliac tied. Both ligatures came away, an the operation wound healed, but the patient died about three months later of exhau tion, associated, apparently, with necrosis in the gluteal region. In the second ca the common iliac was tied for a gunshot wound believed to be of the gluteal artery, i which the hæmorrhage was not arrested by tying the internal iliac. The hæmorrhag recurred, and death took place two days later. The third case was one of diffus aneurysm of the right buttock and iliac fossa resulting from a bayonet-stab in th former region. Death took place four days later from gangrene of the sac. The old operation is considered by Dr. Otis to have been preferable in this case, but as the necropsy showed that the anterior trunk of the internal iliac had been wounded, within the sacro-sciatic notch, by the bayonet, it is difficult to see how the case could have been treated save by ligature of the internal iliac, either outside or within the peritonæum, and then by opening and filling the aneurysmal sac with aseptic gauze or sponges. The fourth case was one of aneurysmal varix of the femoral vessels from a punctured wound two inches below Poupart's ligament. In this case, owing to the impossibility of separating the peritonæum, this was incised, and the common iliac thus secured. Peritonitis proved fatal four days later. Here ligature of the artery lower down, above and below the original seat of injury, would have been better treatment.

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* Mr. Holmes draws attention also to this most important point—*i.e.*, that rapi coagulation in an aneurysmal tumour cannot be regarded as in itself a means of cur but only as the commencement of a process which, if not interrupted, may result i cure, and that thus, while pulsation may diminish soon after a trial of compression, i may not absolutely cease for quite a month.

† It would naturally be thought that hæmorrhage from a wound of the commo iliac would be fatal before a ligature could be applied. Dr. Otis gives a case in whic this vessel was wounded by a ball entering from the buttock through the sacro-ilia synchondrosis. Death took place from hæmorrhage on the second day.

‡ *Amer. Journ. Med. Sci.*, 1860, vol. xl. p. 17.

§ *Med. and Surg. Hist. of the War of the Rebellion*, pt. ii. p. 333.

3. For the arrest of hæmorrhage apart from aneurysm.—Such cases may be met with after amputation near the hip, followed by secondary hæmorrhage from the branches of the internal iliac in what is usually the posterior flap.

Mr. Liston (*Lond. Med. Gaz.*, April 24, 1830) published a case of this kind in which, after amputation below the trochanter minor for necrosis of the femur, hæmorrhage occurred from the stump on the seventh day. As this could not be arrested, the common iliac was tied, but the patient died twenty-four hours later.

Dr. Packard (*loc. supra cit.*, footnote, p. 10) treated a somewhat similar case in the same way, successfully.

This case is especially interesting, as the hæmorrhage occurred from branches of the internal iliac after a Furneaux Jordan's amputation, a method which has lately come largely into vogue, and which would usually be expected to do away with the above risk.* Hæmorrhage occurred from the stump on the sixth day, and, as pressure failed, the common iliac was tied. The patient ultimately did well.

It will not, it is hoped, seem a hasty criticism on the above if I say that in future cases opening up the flaps and plugging with aseptic gauze, or the application, for some days, of Spencer Wells's forceps, aided by even pressure on the flaps and pressure on the common or external iliac, would be preferable to submitting the patient here to the severe and risky operation of ligature of the common iliac.

4. For pulsating tumours simulating aneurysm.—As these growths from the iliac fossa and the walls of the pelvis have been found to be malignant, it is of the utmost importance to form a correct diagnosis in these cases, and thus save a patient who has a certainly fatal disorder from being submitted to an operation which is most dangerous, and almost certain to be useless.† As mistakes have, however, been made in these cases by excellent surgeons,‡ the chief points of diagnosis, as

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* In Dr. Packard's case the Furneaux Jordan's amputation was performed probably higher up than usual, owing to osteo-myelitis, after a previous amputation for growth, at about the middle of the thigh.

† In Guthrie's case, a pulsating tumour in the right buttock, the size of an adult head, diminished by one-half in a month. Two months later it again enlarged, and the patient dying eight months after the operation, an immense encephaloid tumour was found occupying the right iliac region.

‡ *E.g.*, Guthrie (*Lond. Med. Gaz.*, vol. ii. 1834); Stanley (*Med.-Chir. Trans.*, vol. xxviii.); Moore (*ibid.*, vol. xxxv.).

given by Mr. Holmes,* may be briefly mentioned here: (1) The bruit is usually less well marked; (2) the pulsation is less heaving and less expansile; (3) the condition of the bone with which the swelling is connected; thus a plate of bone may be found in the supposed aneurysmal sac; the supposed aneurysm may be found both on the gluteal and the iliac aspects of the pelvis, the bone being expanded by the growth. (4) Cancerous cachexia may be present, and perhaps secondary growths as well.

5. For hæmorrhage, not the result of a wound.—Ligature of the common iliac has been employed in some cases of this nature, usually secondary hæmorrhage after ligature of the external iliac, the gluteal and sciatic, or after rupture of the external iliac. Ligature of the main trunk has been so fatal here that it should be abandoned; carefully applied pressure, aided by plugging with aseptic gauze, or the old operation, being certainly preferable.

Mr. Morrant Baker has put on record † a case of great interest in diagnosis, in which an abscess from sacro-iliac disease ulcerated into branches of the internal iliac artery, and when opened gave rise to hæmorrhage calling for ligature of the common iliac. A gardener, aged 17, had felt pain a month previously while digging. A tense, elastic swelling, distinctly fluctuating, and acutely tender, occupied all the right buttock. It was opened, and a small stream of apparently arterial blood escaped without jets. On further exploration the finger entered a large cavity between the iliac bone and the glutei. The iliac fossa was full and tense, and on examination per rectum a swelling was found in the right ischio-rectal fossa. On enlarging the gluteal wound a steady stream of arterial blood welled up through the great sacro-sciatic foramen. This was firmly plugged, and the common iliac tied. On removing the plug some bleeding still occurred, but was easily arrested. The gluteal wound became offensive, and this region, together with the upper part of the thigh, became gangrenous, the leg and foot remaining unaffected. The patient died forty hours after the operation.

At the necropsy the sacro-iliac joint was open, with surrounding caries. The remains of a large abscess were found, involving the branches of the internal iliac. There was no trace of aneurysm.

6. Preparatory to the removal of caries of pelvis.—Where, after amputation at the hip-joint, pelvic caries persists, leading steadily to lardaceous disease, I think an attempt should be made to remove all of the innominate bone which is diseased. Such profuse oozing follows that the common iliac should first be tied.

I adopted this course in a boy aged 9, eleven years ago. The common iliac was most easily tied by the free anterior abdominal incision given below, and the pubic part of the bone removed the same day. A little later I removed the ischium and the acetabular portion of the ilium, leaving the upper half. Bronchitis (increased, I fear, by the ether given at the second operation) carried off the child three weeks after ligature of the common iliac. The bleeding was slight and easily arrested, the chief difficulty met with here being the detachment of the soft parts in the neighbourhood of the pubes, tuber ischii, and sacro-iliac joint. The thickening of the pelvic fascia, present in these advanced cases, shuts off the contents of the pelvis.

Surgical Anatomy.—The common iliacs, coming off on the left side of the fourth lumbar vertebra, incline downwards and outwards to divide, opposite to the lumbo-sacral intervertebral disc, into the internal and external iliacs. The right is rather the longer and more oblique of the two. Their length is usually an inch and a half. Their branches are few and small—viz., to the ureter, psoas muscles, glands, &c. The iliacs become increasingly tortuous with age: a point of importance in tying the vessel on an aged corpse.

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* *Syst. of Surg.*, vol. iii. pp. 44, 145. The reader should also consult Mr. Holmes's article, "On Pulsating Tumours which are not Aneurysmal, and on Aneurysms which are not Pulsating Tumours" (*St. George's Hosp. Rep.*, vol. vii.).

† *St. Barthol. Hosp. Rep.*, vol. viii. p. 120.

LINE.—One drawn from a point 1½ inch below and a little to the left of the umbilicus to the centre of Poupart's ligament, the line curving a little outwards, will represent the course of the artery with sufficient accuracy.

GUIDE.—The above line is the only surface guide: more deeply the lumbo-sacral articulation and the psoas muscles are useful guides, especially in a thin subject.*

RELATIONS:—

IN FRONT.

Peritonæum; small intestine; cæcum and appendix, sometimes.
Ureter.
Sympathetic.

OUTSIDE.		INSIDE.
Psoas. Vena cava. Right common iliac vein.	Right common iliac artery.	Left common iliac vein.

BEHIND.

Right and left common iliac veins.

IN FRONT.

Peritonæum; small intestine.
Sympathetic.
Ureter.
Superior hæmorrhoidal artery.

OUTSIDE.	
Psoas.	Left common iliac artery.

BEHIND.

Left common iliac vein.

Collateral Circulation.—The chief vessels are:

ABOVE.		BELOW.
Internal mammary and lower intercostals	with	Deep epigastric.
Lumbar	,,	Ilio-lumbar and circumflex iliac.
Middle sacral	,,	Lateral sacral.
Superior hæmorrhoidal	,,	Inferior and middle hæmorrhoidal.

In addition, the pubic arteries anastomose behind the symphysis.

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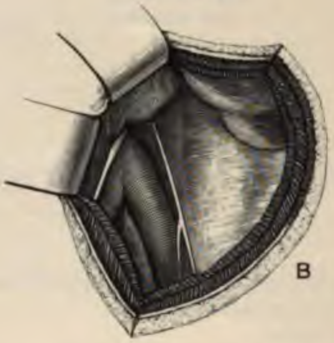
* Attention has been drawn to the need of employing touch, as well as sight, in the ligature of these large trunks (p. 6).

Operations (Figs. 4 and 5).—The common iliac may be tied by ope tions based upon one of three incisions : (1) An anterior abdominal, which the vessel is approached more directly from the front; incision based upon those for tying the external iliac, and made use by Dr. Mott, of New York, who first tied this vessel for aneurysm 1827. (2) A posterior abdominal, or loin incision, by which the ves is reached from behind; a method made use of by Sir P. Crampton, Dublin, in 1828, and by Mr. Stanley, at St. Bartholomew's, in 18 (Fig. 5).

(1) *Anterior Abdominal Incision.*—The preparatory treatment is h the same as that for the external iliac. The parts being shaved a cleansed, a curved incision, 5 to 8 inches long, according to the amou of fat, the development of the body, and the size of the aneurysm, made, commencing just outside the centre of Poupart's ligament a 1½ inch above it, then carried outwards, reaching towards the crest the ilium, then upwards towards the ribs, and finally curving inwar towards the umbilicus, till sufficiently free to admit of the necessa manipulations for reaching the artery. The three abdominal muscl are cut through, either on a director, or with careful light sweeps c the knife, till the fascia transversalis is reached; any vessels whic bleed being at once secured with Spencer Wells's forceps. The fasci transversalis, which may generally be known from the peritonæum b the layer of extra-peritonæal fat which usually intervenes between th two, is then picked up and divided on a director, at the lower part of th wound where it is best marked.* Adoption of the Trendelenberg posi tion will facilitate the remaining steps. The peritonæum is next raise upwards and inwards, first one finger, and then more, being insinuate towards the middle line until the psoas is reached. On the inner sid of this muscle the artery will be found, the external iliac being trace up if needful. In order to aid the surgeon in the difficulties whic

FIG. 4.



Ligature of the left common iliac artery. The peritonæum has been drawn upwards and inwards, and the bifurcation of the common iliac artery exposed. (Compare Fig. 1, B, and Fig. 2.) (Heath.)

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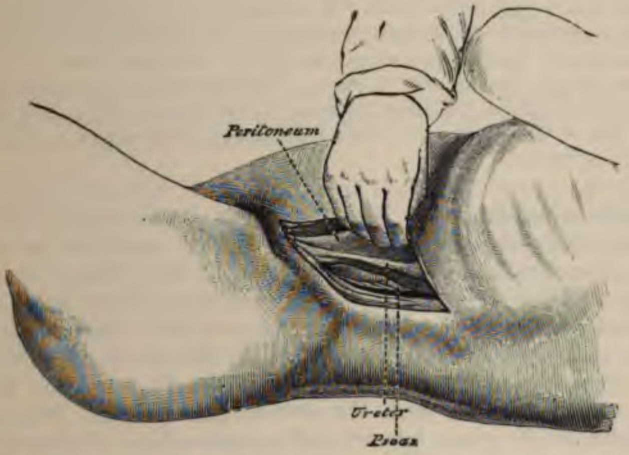
* Dr. Liddell (*Intern. Encycl. of Surg.*, vol. iii. p. 312) recommends that the separa tion of this fascia from the peritonæum should be begun at the upper part of th wound, where the adhesion is slightest.

are now met with, owing to the artery lying at the bottom of a very deep wound, the abdominal walls should be relaxed by bending up the thighs, the wound sponged thoroughly dry, and light thrown in by a reflector or electric lamp. Care will, of course, have been taken to divide every layer from end to end equally, and thus to avoid a conical type of wound. The position of the vessel having been made out, it is to be cleaned with a director, especial care being taken on the right side, as here both the common iliac veins lie behind the artery. The needle should be passed from within outwards.

(2) *Posterior Incision, partly in Abdomen, partly in Loin.*—This

FIG. 5.



Ligature of common iliac by a posterior incision. This would also be available for the abdominal aorta. (Bryant.)

operation will be best given in the words of Sir P. Crampton,* who first introduced it:

> "The first incision† commenced at the anterior extremity of the last false rib, proceeding directly downwards to the ilium; it followed the line of the crista ilii, keeping a very little within its inner margin, until it terminated at the superior anterior spinous process of that bone; the incision was therefore chiefly curvilinear, the concavity looking towards the navel. The abdominal muscles were then divided to the extent of about an inch, close to the superior anterior spinous process, down to the peritonæum; into this wound the forefinger of the left hand was introduced, and passed slowly and cautiously along the line of the crista ilii, separating the peritonæum from the fascia iliaca. A probe-pointed bistoury was now passed along the finger to its extremity, and by raising the heel of the knife, while its point rested firmly at the end of the finger as on a fulcrum, the abdominal muscles were separated from their attachments to the crista ilii by a single stroke. By repeating this manœuvre the wound was prolonged until sufficient room was obtained to pass down the hand between the peritonæum and the fascia iliaca. Detaching the very slight connections which these parts have with each other, I was able to raise up the peritonæal sac, with its contained intestines, on the palm of my hand from the psoas magnus and iliacus internus muscles, and thus obtain a distinct view of all the

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* *Med.-Chir. Trans.*, vol. xvi. p. 161.

† The patient would, of course, be rolled over on to the sound side.

important parts beneath; and assuredly a more striking view has seldom presented to the eye of the surgeon. The parts were unobscured by a single dr blood: there lay the great iliac artery, nearly as large as my finger, beating aw at the rate of 120 in a minute, its yellowish-white coat contrasting strongly wit dark blue of the iliac vein which lay beside it, and seemed nearly double its the ureter in its course to the bladder lay like a white tape across the artery in the process of separating the peritonæum it was raised from it with that memb to which it remained attached. The fulness of the iliac vein seemed to vary time to time, now appearing to rise above the level of the artery, and now to su below it. Nothing could be more easy than to pass a ligature round an arte situated. The forefinger of the left hand was passed under the artery, which, a little management, was easily separated from the vein; and on the finger (served as a guide) a common eyed probe, furnished with a ligature of moist catgut, was passed under the vessel. A surgeon's knot was made in the liga and the noose gradually closed, until Mr. Colles, who held his hand pressed upo tumour, announced that all pulsation had ceased. A second knot was then and one end of the ligature cut off short." Unfortunately, the catgut of that became quickly dissolved, pulsation returned in the tumour within fifty hours o operation, and on the tenth day profuse secondary hæmorrhage took place, following immediately.

Comparison of the Two Methods.—Sir P. Crampton thus sp of his own and Dr. Mott's operation: "The operation of tying common iliac artery is not only a feasible but (when performe the manner described in this paper) an exceedingly easy operat The difficulties which Dr. Mott encountered, and which prolonged operation to nearly an hour,* are clearly referable to the circumst of his incision having been made too low. This, in the first pl brought him in contact with the aneurysmal tumour, from which was obliged, with great labour and considerable risk, to detach peritonæum; then he had the whole mass of the tumour between and the artery which he was to tie; and, lastly, he had the intesti pressing down upon him and producing such a complication of d culties as I believe few men but himself could have encountered w success."

Mr. Skey (*Operative Surgery*, p. 294) preferred the posterior incis for these reasons: (1) It is a part less liable to consequent inflammati (2) The requisite separation of the peritonæum is less extensive. (3) artery is brought better into view, the act of passing the needle ro it being made visible to observers around. (4) The line of the vesse sufficiently exposed to enable the operator to select his site of ligat to carry it either higher or lower, or even, if necessary, to separate peritonæum from the aorta itself, and to pass a ligature around t vessel at a sufficient distance from its bifurcation. (5) The format of a ventral hernia is not likely to occur.

To the above Mr. Skey might have added that the posterior incis gives far better drainage to the wound.

The difficulties of the operation and the causes of failure a of death are much the same as those already given in the account ligature of the external iliac (pp. 8–10).

(3) *Intra-peritonœal Method.*—See page 22.

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* Sir P. Crampton's operation was completed in twenty-two minutes.

LIGATURE OF THE INTERNAL ILIAC.

Indications.—Very few and rare.

i. In some cases of gluteal and sciatic aneurysms.—Mr. Holmes in the course of those lectures from which I have already quoted, lays down conclusions which will very greatly help the surgeon in deciding what form of treatment is best suited to these aneurysms. They are quoted below under the heading of Ligature of the Gluteal Artery (p. 25).

ii. Hæmorrhage.—This is most frequently met with in military surgery after gunshot wounds of the vessel itself, but more often of one or more of its branches within the pelvis, the ball entering usually from the front through the inguinal region or behind through the sacrum.

Four such cases are given by Dr. Otis,* all being fatal. Two cases, in which this artery was tied for wounds of the sciatic and gluteal respectively, are given by the above writer (p. 332); both were fatal from hæmorrhage.

Dr. Liddell,† who, as U.S.A. Medical Inspector, saw much of military surgery, gives the following advice in cases of punctured wounds of this artery or its branches: "The wound should be explored by introducing the finger into it for the purpose of locating by touch the precise point whence the blood issues by jets into the wound. If the punctured artery is found to be external to the pelvis, the bleeding point should be laid bare by enlarging and cleansing the wound, and the vessel secured by ligatures placed on each side of the aperture. But if it be shown, by the occurrence of intra-pelvic extravasation of blood, or by other signs, that the internal iliac artery, or some branch thereof, is wounded within the pelvis, it will be impossible to reach and tie the punctured artery, in the wound. Under these circumstances it sometimes becomes very difficult to decide what plan of treatment should be adopted. . . . One thing," Dr. Liddell goes on to say, "ought never to be done, that is, trusting to the use of iron perchloride or persulphate.‡ The first thing to be tried, in most cases, is compression. It should be applied to the common iliac artery, and, at the same time, to the wound itself, if possible, with a view to obtain coagulation of the blood in, and obliteration of, the wounded artery. The very desperateness of these cases makes it all the more necessary to use the compression faithfully, intelligently, and persistently, otherwise a traumatic aneurysm will form." Nowadays, laparotomy will very likely be resorted to (p. 22).

iii. To bring about atrophy of the enlarged senile prostate.

Dr. Bier, first assistant to Prof. von Esmarch, of Kiel, was the first to tie the internal iliacs for the above purpose (*Wien. Klin. Woch.*, No. 32, Aug. 10, 1893).

He did this in three cases, in one intra-peritoneally, and in two extra-peritoneally. The latter two made good recoveries. In the first case the way in which the anæsthetic was taken caused so much trouble that, Trendelenberg's position failing, it was found needful to withdraw a large part of the small intestine, in order to reach the arteries. This patient died of septic peritonitis on the third day.

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* *Med. and Surg. History of the War of the Rebellion*, pt. ii. p. 331.

† *Intern. Encycl. of Surg.*, vol. iii. p. 125.

‡ See the remarks, vol. i. p. 578.

Dr. W. Meyer (*Ann. of Surg.*, July 1894) publishes a case treated by Bier's method.

The patient was 55, and very stout. For six months he had been unable to pass any urine, having to rely on a catheter altogether. The prostate was generally enlarged its upper border could only just be reached *per rectum.* The extra-peritonæal method was adopted. The left artery was taken first. An incision, slightly concave inwards and five inches long, was made parallel with the upper third of Poupart's ligament and running up towards the tip of the eleventh rib. The common and internal iliacs were reached without much trouble. The artery was tied with catgut, but the vessel having been punctured when the sheath was divided, two ligatures were applied on either side of the puncture, and the artery was divided between them. The ligature on the proximal end slipped off, and further attempts to place a ligature proving futile, a long pair of artery forceps was placed on each divided end, and left *in situ*, being carefully packed around with gauze. The right internal iliac was then tied with a double catgut ligature but the vessel was not divided. The two forceps were removed on the fifth day, no hæmorrhage following. On the twelfth day arterial hæmorrhage took place from the track of the forceps on the left side. On opening up the wound it was found that the bleeding came from an opening in the external iliac, due to the pressure of the forceps where it crossed this vessel. Pressure being made on the common iliac, the external was tied above and below the perforation, and then the common iliac was tied also, silk being used on this occasion. Partial gangrene of the foot followed, necessitating an irregular amputation of its anterior part. The influence of tying both internal iliacs in the enlarged prostate in this interesting case was as follows: Twelve hours after the operation the patient began to pass his water (twenty ounces) in a fine stream for the first time for six months. This improvement slowly increased, though it was evident that there was marked atony of the bladder. The patient gained sufficient power to hold his water two, or even three or four, hours. and then to pass ten or twelve ounces in a forcible stream. The residual urine remained considerable, ten ounces or more. The prostate became almost normal in size, and the length of the urethra became reduced from 23½ to 21½ cm., the length of a normal urethra being 21 cm.

Dr. Meyer also operated according to this plan on a man, aged 63, with retention due to hypertrophy of the prostate. A single silk ligature was easily placed around each artery within its sheath, and tied. The wound healed without reaction. The patient voided his urine in a fine forcible stream several times during the night after the operation. Retention did not again set in. On the fifth day after the operation the temperature became subnormal without apparent cause, and the patient died comatose three days later. Only a very limited necropsy was permitted, and there is no account of the state of the kidneys.

We have seen that the two cases in which Dr. Bier operated by the extra-peritonæal method recovered. Neither, before the operation, had been able to pass a drop of urine. Spontaneous power returned in each case, and improved progressively, one of the patients stating, four months later, that he could micturate as well as ever before.

iv. In some cases of vascular pelvic sarcoma, and inoperable uterine tumours (Baudet and Kendirdjy, *Gaz. des Hôpitaux*, April 1, 1899).

v. Also as a prophylactic against hæmorrhage in the course of certain pelvic operations, such as abdominal panhysterectomy, and in abdomino-perinæal excision of the cancerous rectum (Baudet and Kendirdjy, *loc. supra cit.*).

Surgical Anatomy.—A short trunk, about an inch and a half long, of large size, the internal iliac, given off opposite to the lumbo-sacral intervertebral disc, dips downwards and backwards as far as the upper part of the sacro-sciatic notch, where it gives off its anterior and posterior trunks, a ligamentous cord also coming off from the bifurcation: this cord, the remains of the obliterated hypogastric artery, usually remains pervious as far as the bladder, as one of the vesical arteries.

LINE.—No distinct line or guide can be given for this vessel owing to its at once dipping into the pelvis, but it will be worth while to remember that a line drawn with a slight curve outwards from a point about an inch below and a little to the left of the umbilicus, to the centre of Poupart's ligament, gives sufficiently accurately the line of the common and external iliac arteries: the internal is given off about two inches from the commencement of this line.*

RELATIONS :—

IN FRONT.
Ureter.
Peritonæum.
Rectum (left side).

OUTSIDE.		INSIDE.
Right internal iliac vein. Obturator nerve.	Internal iliac.	Pyriformis. Sacral nerves.

BEHIND.
Internal iliac vein.
Sacro-iliac synchondrosis.
Lumbo-sacral cord.

Collateral Circulation.

Sciatic	with	Superior branches of profunda.
Hæmorrhoidal branches	,,	Inferior mesenteric.
Pubic branch of obturator	,,	Vessel of opposite side.
Branches of pudic	,,	Branches of opposite vessel.
Circumflex and perforating of profunda	,,	Sciatic and gluteal.
Lateral sacral	,,	Middle sacral.
Circumflex iliac	,,	Ilio-lumbar and gluteal.

Operation.—The preparatory treatment being the same as in ligature of the external iliac (p. 5), the surgeon makes an incision much as in the case of the common iliac, or else, in the words of Dr. Stevens (who first tied the vessel successfully in 1812), "one about five inches long, parallel with the deep epigastric artery, and nearly half an inch on the outer side of it." The peritonæum having been raised up, the hips are well flexed and the lips of the wound retracted as widely as possible: the finger now finds the external iliac, and then, by tracing it up, the internal iliac vessel.† The cord of the obturator nerve must not be mistaken for this.‡

The artery is now separated, partly with the finger-nail and partly with the point of the director, and the needle passed from within outwards, avoiding the vein and psoas muscle. The ureter usually crosses the artery at its commencement, and will be out of harm's way. It will be well to have in readiness aneurysm-needles of different curves, and an ordinary silver eyed-probe.

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* The origin of the arteries will be found nearly opposite to the centre of a line drawn from the anterior superior spine to the umbilicus.

† The finger should be passed downwards and backwards towards the sacro-iliac synchondrosis.

‡ In cases of doubt the artery should be compressed gently between the finger and thumb.

Ligature of the Internal and other Iliacs by Abdominal Sectio —This method has been advocated recently by Dr. Dennis,* of Ne York, on account of the following advantages:—(1) Abdominal sectic in no way increases the dangers of the operation of ligature of tl internal iliac. (2) This method prevents a series of accidents whic have occurred during the performance of the operation of ligature this artery by the older methods. Amongst these are, the division the circumflex and epigastric arteries, wounding the vas deferen including the ureter in the ligature, puncturing the iliac or circumfle veins, tying the genital branch of the genito-crural, tearing the per tonæum, injury to the sub-peritonæal connective tissue, celluliti (3) Abdominal section enables the surgeon to apply the ligature a point of election, and to obtain information as to the exact extent the disease in the main arterial trunk. (4) Securing the internal iliac b this method takes much less time than was occupied by the older ones.

Three cases are given by Dr. Dennis, two of which occurred in hi own practice:

I. A woman, aged 60, presented pulsatile tumours in both gluteal regions, th tumours dating back a year and a half, and pain three years back. The external part being thoroughly purified, a median incision was made from the umbilicus to th pubes; the small intestines, which would have hindered the operation, were drawn ou into warm moist sponges and towels, the internal iliacs of both sides ligatured wit catgut, the viscera returned, the wound closed, and aseptic dressings applied. Th patient died, with suppression of urine and slight parenchymatous nephritis, on th third day. II. A negro, aged 46, had a right gluteal aneurysm, the trouble dating bac seven months. By a curved lateral incision the abdomen was opened; owing to th violent efforts of the patient, and the difficulty of manipulation, a few coils of intestin were drawn out, a strong silk ligature applied to the internal iliac, the parts cleansed and the wound closed. A cure followed. III. A female, aged 18, had an aneurysmal varix of the left side, the trouble dating back many years. Under careful antiseptic treatment the abdomen was opened, the incision finally extending from the symphysis to some distance above the umbilicus, the intestines drawn out sufficiently to admit of exposure of the vessel, a double twisted catgut ligature applied to the left internal iliac, the bowels returned, and the wound treated as before. The patient rallied quickly, and the bowels were moved normally on the fifth day; a slight acute albuminuria, due to congestion of the kidney from the ligature of the main trunk of the internal iliac, appeared on the following day, but soon disappeared. The aneurysm, together with the aneurysmal varix, was perfectly cured.

A few cases in which the iliac arteries have been tied intra-peritonæally in this country are on record. One of the most interesting of these is fully recorded by Mr. Makins (*Lancet*, vol. ii. 1892, p. 1328).

The patient, aged 30, had an inguinal aneurysm, about two inches in breadth, extending upwards about two-fifths of the distance between the middle of Poupart's ligament and the umbilicus, and for about two inches below the ligament. An incision four inches long was made in the left linea semilunaris; the deep epigastric, which originated in the swelling, was tied between two ligatures. The small intestines were held over to the right with Messrs. Ballance and Edmunds' broad abdominal retractor, the sigmoid flexure was pushed upwards, and an incision made through the lower part of its mesentery and the peritonæum at the margin of the pelvis in the course of the external iliac. The wound was deep, there being about an inch and a half of subcutaneous fat, and abundance of fat in the sub-peritonæal tissue, both beneath the anterior abdominal wall and around the vessel. This, together with some retching, rendered the freeing of the artery and the passage of the ligature a process of some difficulty. The spermatic vessels were also exposed and swelled up considerably in the wound. The artery was secured about three-quarters of an inch below the bifurcation of the common iliac, and an inch and a half above the sac. Two threads of stout flossy sterilised silk were tied separately, but in close apposition, and with sufficient firmness to rupture the internal and middle coats. The posterior peritonæum was sutured over the artery. The patient left the hospital, with the aneurysm hard, painless, and shrinking, on the forty-seventh day.

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* *New York Med. News*, Nov. 20, 1886; *Annals of Surgery*, vol. v. No. 1, p. 55. I am indebted to the latter periodical for the above account.

The following remarks from Mr. Makins, well known not only as a surgeon but also as an anatomist, I quote *verbatim:*

"The reason for selection of the intra-peritonæal method in this case was the high position of the aneurysm. Before operation the pulsation in the iliac fossa was so forcible and extensive that it seemed probable that it might prove necessary to ligature the common iliac, and it was thought that this would be more readily performed by the intra-peritonæal method. Beyond this the intra-peritonæal method seemed to offer the great advantage of not in the least interfering with the coverings of the sac, which, by the ordinary method, might have been disturbed by the stripping of the peritonæum. The experience gained by the operation showed that the usual method might have been safely adopted, but this could not be definitely determined beforehand. An advantage was gained in ready access to the deep epigastric artery, which, as directly feeding the sac itself, needed ligature, but, of course, might readily have been secured by an extension of the ordinary wound. As to the comparative difficulty of the two operations I think there is little to choose, and on the whole the incision for the extra-peritonæal method is perhaps to be preferred in the matter of cicatrix; in the vertical incision the advantage of suturing the fibrous structures in the linea semilunaris is gained; but, on the other hand, the resulting cicatrix passes directly through from skin to peritonæum. In the oblique incision the decussation of the various muscular layers leads to a certain intricacy and irregularity in the line of the cicatrix which may render it the stronger, since pressure is less readily brought to bear directly upon it. The choice of the iliac vessels obtained is, I think, a real advantage, since the incision needs neither extension nor modification; but in saying this it should be pointed out that this is a much stronger argument on the right than on the left side of the body. Ligature of the right common iliac artery by the intra-peritonæal method is probably the easiest of all the operations on the great arteries, since the vessel lies directly beneath the peritonæum of the posterior abdominal wall, uncovered by any structure of importance. On the left side, on the other hand, the inferior mesenteric vessels as they enter the sigmoid mesocolon and pass down to the mesorectum, cover practically the whole of the artery, and to reach the common iliac comfortably and safely the peritonæum would need to be divided close to the left of the median line of the sacrum and displaced outwards. This manœuvre has the disadvantage of exposing the vein freely, but this would probably give far less trouble than the numerous mesenteric vessels would when swollen by reason of the loss of their peritonæal support. In the case recorded above the distension of the spermatic vessels, when set free by the division of the peritonæum, was much greater than would have been expected."

This most instructive case possesses the additional and especial interest that the patient developed a similar aneurysm on the right side a few months later (*Lancet*, vol. ii. 1893, p. 196).

On May 3, 1893, Mr. Makins tied the right external iliac intra-peritonæally. An incision, commencing an inch below the level of the umbilicus and four inches long, was made in the right linea semilunaris. The abdomen being opened, the small intestine was packed away with two small sponges and the posterior wall exposed. The artery was then seen below the termination of the ileum, crossed by the spermatic vessels. The aneurysmal sac was about an inch and a half in diameter. The peritonæum over the artery being divided, the vessel was ligatured with two strands floss silk, tied with separate reef-knots, and then the peritonæum sutured over t artery. The patient was kept in bed for two weeks, and went out on the thirty-eigh day, having made an excellent recovery. A firm linear scar was present in the l linea semilunaris, and two small, hard swellings marked the site of the cured aneurys Mr. Makins stated that he repeated the trans-peritonæal method here, because the fi had proved so successful, and because the aneurysm, though small, was situated entire above Poupart's ligament. The operation on the right side proved much easier th that on the left, since the crossing of the ileum was on a higher level than was the ca with the sigmoid mesocolon. The artery also was far more prominent on the brim the pelvis. The circulation was re-established much more rapidly and satisfactori after the second than after the first operation. On the first occasion the limb was ve cold, and the patient suffered much neuralgic pain; on the second the local temperatu fell little, if at all, and the patient had no pain. On the first occasion the deep epiga tric was tied, a step not taken on the second, but Mr. Makins was inclined to think th the rapid re-establishment of the circulation was rather dependent on the enlargeme of the branches of the internal iliac on the opposite side resulting from the obstructio of the first external iliac artery.

The two following cases, in which abdominal section was resorte to for ligature of the external iliac, show a striking contrast in th difficulties which may be met with:

In Mr. Mitchell-Banks' case (*Brit. Med. Journ.*, vol. ii. 1892, p. 1163), the patien aged 62, had an ilio-femoral aneurysm as big as a fist occupying the upper part of th right Scarpa's triangle, pushing its way up beneath Poupart's ligament. On Septembe 20, 1892, the abdominal cavity was opened by an incision about three inches long i the right linea semilunaris. The cæcum and small intestines which came into view wer held apart by the hands of an assistant. The position of the external iliac being readil detected, the artery was tied with catgut, and sufficient pressure used to stop th pulsation in the aneurysm, and no more, no attempt being made to divide the interna coat. The incision in the peritonæum immediately over the artery was stitched up wit fine catgut, so as to make the artery and ligature once more extra-peritonæal. Th patient's recovery was uninterruptedly successful, save for one incident. On th eleventh day the sudden onset of acute præcordial pain and cyanosis, dyspnœa, and collapse were thought to point to detachment of some bit of clot from the neighbourhood of the ligature. These complications gradually disappeared. For some time the aneurysm contained fluid at one part, but gradually contracted, and the patient went out on the forty-second day after the operation.

Mr. Banks states that he made use of the abdominal section here because the aneurysm pushed well up beneath Poupart's ligament, and he could not make out with certainty what was the condition of the artery above it.

The second case, under the care of Mr. W. H. Brown, of Leeds, tells a very different story of the difficulties which may attend ligature of the external iliac by abdominal section:

The patient, a woman, aged 48, was admitted into the Leeds General Infirmary with two femoral aneurysms. The upper one, the size of a large cocoa-nut, occupied the right groin, extending upwards above Poupart's ligament; the second, a smaller one, occupied the middle third of the same right femoral vessel. The skin over the upper swelling was dark, very thin, and threatening to give way. The position of the upper aneurysm was thought to preclude any of the usual operations, and it was decided to tie the external iliac intra-peritonæally, by a median incision. The abdomen was opened by an incision at first four and later six inches long, owing to the great amount of fat in the abdominal wall. The omentum was also very thick and greatly embarrassed manipulation. It was only after the pelvis had been well raised and emptied of the small intestines that a view could be obtained of the vessel. Mr. Brown states that he had the greatest difficulty in obtaining, first of all, a view of the vessel; secondly, in passing the ligature. So far as the abdominal conditions were concerned the patient made a good recovery, but the foot and leg becoming gangrenous, amputation of the thigh became necessary. The patient sank about ten weeks after the ligature of the artery.

Mr. Wherry (*Lancet*, vol. ii. 1893, p. 136) made use of the intra-peritonæal method for ligature of the left internal iliac in a case of large pulsating sarcoma of the upper, outer, and back part of the innominate bone. The swelling was too large and vascular to admit of its removal safely.

"An incision was made from below the umbilicus to the pubes. There were two difficulties. Firstly, the vein, which was very large and much in the way, was swollen by the slightest pressure of sponges or retractors upon the upper part. The external or common iliac would have been much easier to tie in this case. There was some venous bleeding which stopped after the artery was tied, but the vein also was tied by a ligature just below the first one to make it safe. The other difficulty was with the light. Large reflecting refractors were of the greatest use, but an electric light would have been better still." The patient made a good recovery. The swelling at once shrank and ceased to pulsate, and the relief to pain and other distressing symptoms was very great, but no further result is given.

Mr. Treves (*Operative Surgery*, vol. i. p. 213) made use of this method in a boy, aged 16, with a vascular tumour of the buttock, in November 1889. He employed an incision from the umbilicus to the pubes, and kept the intestines packed up and aside with six sponges.

The following is Mr. Treves' opinion of the merits of the operation (*loc. supra cit.*, p. 211), and he is inclined to extend this method to the common iliac also: "The advantages of this method are obvious. The vessel is easily and fully exposed, and the needle can be passed without risk to the vein or ureter. The operation is simple, and involves but little time. Its dangers are, comparatively speaking, very few. The ligature can be applied accurately at the spot determined upon. The condition of the artery and the surrounding parts can be made out, and a diagnosis confirmed or modified. The great objection that some few years ago would have been urged against the procedure—the risk of acute peritonitis—may be at the present day almost disregarded."

Writing as I do for those whose operative experience is not to be compared with that of Mr. Treves, I hesitate to endorse the above opinion in its entirety. I am of opinion that with the above incision the intestines will sometimes give great trouble. A good deal of handling and exposure will be inevitable, and we all know that where the above are entailed, septic peritonitis does still, in spite of the advantages of modern surgery, tend to appear. In fairness I must add that I have only once tied either of the iliac vessels—the common iliac, in the case mentioned at p. 14. The free incision there made use of would have rendered the securing of the internal iliac as easy as it did that of the parent trunk. In gunshot injuries or stabs, the intra-peritonæal method will, of course, be made use of. My readers should refer to Mr. Makins' opinion on the intra-peritonæal method, quoted at p. 22.

LIGATURE OF THE GLUTEAL ARTERY.

Indications.

1. Stab. 2. Aneurysm. 3. Hæmorrhage after opening an abscess. All are rare, especially the last.

1. Stab.—The source of the bleeding from a stab in the buttock may be very difficult to tell exactly. The surgeon may be guided by the position of the exit of the gluteal and sciatic vessels (Fig. 6); he will remember the outline of the gluteus maximus, the lower border of this muscle forming the fold of the buttock, the upper starting from the crest about two inches in front of the posterior superior spine, and running downwards and forwards to the greater trochanter. Hæmorrhage from a stab in the upper part of this muscle will probably come from the gluteal; if from the lower part, from the gluteal or sciatic.

2. Aneurysm.—This affection is so rare that it will be sufficient to quote the following conclusions of Mr. Holmes:*

(1) "Gluteal aneurysms, both traumatic and spontaneous, are very favourably circumstanced for the treatment by either rapid or gradual compression applied to the aorta or common iliac."

Mr. Holmes points out that gluteal aneurysm, if not ruptured, is usually of no great size, and does not encroach upon the abdomen, and thus any part of the common iliac or aorta is accessible to pressure.

(2) "If this treatment, with or without anæsthetics, does not succeed by itself, it may be supplemented by coagulating injection or galvano-puncture, while the patient is narcotised, and the circulation commanded." Of the two Mr. Holmes prefers galvano-puncture.†

(3) "When such treatment fails, and particularly in aneurysms with imperfect or ruptured sacs, where it is not indicated, the internal iliac must be tied when the surgeon thinks that he cannot find the artery outside the pelvis. But when the artery is accessible, the old operation, or the operation of Anel, should be practised, according to the size and extent of the tumour."

In deciding whether the aneurysm is inside or outside the pelvis, the surgeon will see if the pulsation can be commanded by pressure on the artery above the aneurysm, whether the latter can be lifted from the bone, and will also make an examination by vagina or rectum.‡

The old operation must always be formidable, and while modern tourniquets may admit of efficient pressure, there is always the risk of fatal hæmorrhage from the artery having retracted into the pelvis.

The method of Anel does not seem likely to be often useful: of three cases, one only has been successful.

(4) "The ligature of the internal iliac is liable to failure in cases of spontaneous aneurysm from a diseased condition of the coats of the artery, and should always be avoided when other means of treatment are available."

This method has proved fatal in about half the cases operated on. The varying length of the artery, the proximity of the ligature in all cases to large branches and to the sac, have all to be remembered.

Here also ligature of the artery by laparotomy will probably be resorted to in the future (p. 22).

Surgical Anatomy of the Gluteal Artery.—A short, thick branch from the posterior division of the internal iliac, this leaves the pelvis above the pyriformis, through the sacro-sciatic notch. Immediately after its exit it divides into a superficial and a deep portion. The superficial is mainly distributed to the gluteus maximus; the deep lies between the gluteus medius and minimus, and divides into two, the upper branch running along the origin of the gluteus minimus, and the lower running obliquely across this muscle towards the trochanter major. The superior gluteal nerve emerges just below the artery, and sends branches with the deeper portion.

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* Hunt. Lect., *Lancet*, 1874, vol. ii. p. 76; *Syst. of Surg.*, vol. iii. p. 148.

† See the remarks on the introduction of foreign bodies and galvano-puncture, vol. i. pp. 644 and 648.

‡ An anæsthetic being given, and the hand passed here, if needful.

LINE AND GUIDE.—"If a line be drawn from the posterior superior spine to the great trochanter, the limb being slightly flexed and rotated inwards, the point of emergence of the gluteal artery from the upper part of the sciatic notch will correspond with the junction of the upper with the middle third of this line" (Mac Cormac, *Lig. of Arts.*, p. 126, Figs. 10, 11).

Operation (Fig. 6).—The patient being rolled two-thirds over on to his face, the part well exposed and cleansed, the limb hanging over the edge of the table, an incision, five inches long, is made in a line running from the posterior superior spine to the upper and inner part of the great trochanter. The incision should run almost parallel with the gluteus maximus. The fibres of this muscle being separated, between adjacent fasciculi, with a director, a muscular branch should be found and traced down to the exit of the artery. The gluteus maximus having been relaxed, and the contiguous margins of the gluteus medius and pyriformis separated with retractors, the surgeon, taking as his guide the above line and the aperture of the great sacro-sciatic notch, clears the artery as high up as possible, avoiding the nerve and the veins, and dividing the adjacent muscles if needful. The ligature should be applied as far within the notch as possible, almost within the pelvis, as the artery divides immediately after its exit.

Old Operation.—The following is the account of Prof. Syme's case. The man had been stabbed in the buttock seven years before. The aneurysm measured more than 13 inches in both diameters; this, together with the great thinness and laxity of the coverings being opposed to coagulation, led to the adoption of the old operation.

"The patient having been rendered unconscious and placed on his right side, I thrust a bistoury into the tumour, over the situation of the gluteal artery, and introduced my finger so as to prevent the blood from flowing, except by occasional gushes which showed what would have been the effect of neglecting this precaution, while I searched for the vessel. Finding it impossible to accomplish the object in this way, I enlarged the wound sufficiently for the introduction of my fingers in succession, until the whole hand was admitted into the cavity, of which the orifice was still so small as to embrace the wrist with a tightness that prevented any continuous hæmorrhage. Being now able to explore the state of things satisfactorily, I found that there was a large mass of dense fibrinous coagulum firmly impacted into the sciatic notch, and, not without using considerable force, succeeded in disengaging the whole of this obstacle to reaching the artery. . . . . The gentleman who assisted me being prepared for the next step of the process, I ran my knife rapidly through the whole extent of the tumour, turned out all that was within it, and had the bleeding orifice instantly under subjection by the pressure of a finger. Nothing then remained but to pass a double thread under the vessel and tie it on both sides of the aperture." The case did perfectly well.* (*Obs. in Clin. Surg.*, p. 169.)

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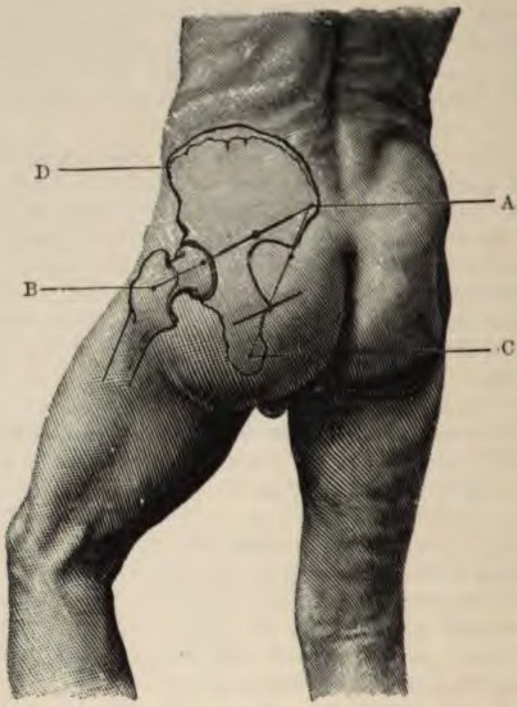
* Nowadays the application of a Lister's tourniquet to the abdominal aorta would facilitate matters. Another successful case is recorded by Mr. J. Bell, *Prin. of Surg.*, vol. i. p. 1801.

If, in the case of a stab, the hæmorrhage continues after the ligat has been applied with the above precautions, and the gluteal has dently been punctured within the pelvis, the internal iliac must be after the wound in the buttock has been firmly plugged with iodof gauze wrung out of carbolic acid (1 in 20).

FIG. 6.



Position and direction of the superficial incisions which must be made to secure the gluteal, sciatic, or pudic arteries.

A. Posterior superior iliac spine.
B. Great trochanter.
C. Tuberosity of ischium.
D. Anterior superior iliac spine.

AB. Ilio-trochanteric line, divided into thirds. This line corresponds in direction with the line of the fibres of the gluteus maximus. The incision to reach the gluteal artery is indicated by the darker portion of the line. Its centre is at the junction of the upper and middle thirds of the ilio-trochanteric line, and exactly corresponds with the point of emergence of the gluteal artery from the great sciatic notch.

AC. Ilio-ischiatic line. The incision to reach the sciatic or internal pudic arteries is indicated by the lower dark line. It is also to be made in the direction of the fibres of the gluteus maximus. The centre of the wound corresponds to the junction of the lower and middle thirds of the ilio-ischiatic line. (Mac Cormac.)

Macewen's Method (vol. i. p. 645).—A case thus treated successfull in the Edinburgh Infirmary by Mr. Miller is recorded (*Brit. Med. Journ* 1893, vol. i. p. 1176):

The patient here was aged 75 on June 1, 1891. The surface of the swelling havin been well cleansed, six long aseptic steel pins were introduced into the sac in differen directions, and made to pass through it until they were felt to impinge against th opposite wall. They were then withdrawn a little so that their points might scratch the inner surface of the cavity. The pulsations of the swelling were sufficiently powerful to move the points of the pins, and to cause them to irritate the internal wall of the aneurysm. They were left in about half an hour, and when withdrawn the punctures were covered with collodion. No anæsthetic was given, nor did the patient complain of much pain. On June 12 the above treatment was repeated, only four pins being used now: since two of those used before were found to be too fine on this occasion, as they bent when force was used to make them perforate the now thickened wall of the aneurysm. On June 25 no pulsation could be detected in the aneurysm, which had shrunk considerably. At this date a pulsating swelling was felt between the xipho-sternum and umbilicus. July 10, the gluteal aneurysm was quite firm to the touch. The abdominal swelling increased rapidly. At first it was thought to be another aneurysm, but it was later diagnosed as malignant, the pulsation of the aorta being transmitted through it. The patient sank on August 30. At the necropsy a large soft sarcoma was found infiltrating the upper part of the abdomen. The gluteal aneurysm was found to be quite firm and solid. It was mostly filled with firm fibrous clot, a small part in the centre being softer.

LIGATURE OF THE SCIATIC ARTERY.

Indications.—Stab. This operation is so rarely required that it may be very briefly described here.

Surgical Anatomy.—The sciatic artery emerges, together with the sciatic nerve and the pudic artery, from the lower part of the great sacro-sciatic notch below the pyriformis.

GUIDE AND LINE.—The limb being rotated inwards, a line is drawn from the posterior superior spine to the ischial tuberosity. The exit of the sciatic and pudic arteries corresponds to the junction of the middle and lower thirds of this line.

Operation (Fig. 6).—The sciatic artery may be found by one of two incisions—(*a*) by a horizontal one, about five inches long, made about an inch and a half below that for the gluteal artery, and, like that, parallel with the fibres of the gluteus maximus; (*b*) by one made vertically in the above given line. The deeper guides will be the margins of the notches, or the great sciatic nerve.

LIGATURE OF THE ABDOMINAL AORTA.

Indications.—As this most rare operation has been fatal in every one of the cases in which it has been performed (some nine or ten), its justifiability has naturally been called in question. On the one hand, the desperate condition of the patients, the advanced amount of disease probably present in their arteries, hearts, &c., the large and rapid blood-current, the disturbance of very vital parts, and the risk of peritonitis, all combine to render the probability of success extremely small. On the other hand, recent improvements in surgery, the introduction of better ligatures, the fact that in these cases life must speedily end if nothing be done, and, perhaps, the fact that many of the major operations of surgery have been unsuccessful at first, will justify surgeons in again making trial of this forlorn hope, if they feel certain that, otherwise, the case is quite hopeless.

The cases have mostly been those of iliac and inguinal aneurysm in which other arteries have been tied without success. To justify the epithet above given of "desperate," the first case, the well-known one of Sir A. Cooper (in 1817),[*] may be alluded to.

Here the patient had long suffered from an aneurysm affecting the external and common iliac arteries, leading to sloughing of the skin and hæmorrhage. Sir Astley having failed in an attempt to perform the old operation, owing to the artery lying so deeply, gave the patient "the only hope of safety" which remained, by tying the aorta.

As life was here prolonged for forty hours, and as in Monteiro's case death did not take place till the tenth day, proof is given of the restoration of the collateral circulation.[†]

Mr. Mitchell Banks records briefly (*Brit. Med. Journ.*, 1892, vol. ii. p. 1164) the following most interesting case:

About fifteen years before, a patient in a state of exhaustion came under his care with a rapidly increasing aneurysmal swelling occupying the left iliac region, and reaching to the middle line in front and to the umbilicus above. "It was impossible to say where it sprang from, but, as the man evidently had only a short time to live, it was necessary to act promptly. I opened the abdomen in the middle line (which was thought rather an adventurous proceeding in those days), with the intention of tying the common iliac, or the aorta itself, if I got a chance. But it was found impossible to do anything. The aneurysm overlapped the left common iliac and the lower portion of the aorta, so that neither of them could be reached. It was a gigantic thing, and had been leaking for some time at the back, tearing up the tissues behind the peritonæum in all directions." The patient sank a few days later. No necropsy is mentioned.

In addition to the above cases, in which the aorta has been tied in cases of aneurysm, it has been tied once for hæmorrhage after a gunshot injury of the upper part of the thigh, by Czerny, of Heidelberg. Hæmorrhage continuing, the common femoral was tied, together with the superficial femoral below the profunda. Bleeding taking place again in six days, the common iliac was tied. The hæmorrhage still persisting, it was thought that the external iliac only had been tied, and a ligature was next placed, by mistake, upon the aorta. The patient lived twenty-six hours. The same surgeon during a nephrectomy for a soft malignant growth of the kidney met with such uncontrollable hæmorrhage as to compel him to tie the aorta, the patient dying soon after.

Surgical Anatomy.—The lowest part of the aorta—viz., that between the bifurcation and the origin of the inferior mesenteric—is that which should be chosen.[‡]

The vessel may have in front of it the omentum, duodenum, mesentery, small intestines, and, more closely, the aortic plexus of the sympathetic, and a layer of fascia of various strength. To the right side lies the vena cava, and behind it are the left lumbar veins. The bifurcation is usually situated a little to the left side of the umbilicus and about three-quarters of an inch below it.

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[*] *Prin. and Pract. of Surg.* (edited by Dr. Lee), vol. i. p. 228.

[†] In comparing instances of the restoration of the circulation, the one by disease and the other after the surgeon's ligature, the importance of the slow and gradual process in the one case will not be lost sight of. Mr. Barwell (*Intern. Encycl. of Surg.*, vol. iii. p. 481) alludes to the experiments of Pirogoff (Waller and von Gräfe's *Journ.*, Bd. xxvii. S. 122) and a paper by Kast (*Zeit. f. Chir.*, Bd. xii. S. 405) to show that the collateral circulation is established. Sir A. Cooper (*loc. supra cit.*) used to show in his lectures an injected specimen from a dog which survived the operation. Beyond this fact, however, no comparison can be made between the chance of survival of healthy animals and that of patients reduced to such straits as to call for this operation.

[‡] This interval varies in length from half an inch to two inches.

Operation.—This may be performed (A) through, or (B) behind, the peritonæum. The intra-peritonæal method is especially indicated when the height at which the ligature must be applied, or any evidence of matting of the structures of the abdominal wall (dating to inflammation about the aneurysm, or to the use of pressure), would probably interfere with stripping up the peritonæum.

A. *Through the Peritonæum.*—The bowels having been emptied as much as possible, the skin cleansed, the shoulders raised, and the knees slightly flexed, the surgeon makes an incision at least four inches long, in the middle line, with its centre opposite to the umbilicus, but curving a little to the left here, so as to avoid the round ligament of the liver and the urachus. The linea alba being found and divided, the fascia transversalis slit up, all hæmorrhage must be arrested before opening the peritonæum.* When this structure has been opened to the whole extent of the wound, retractors are inserted, and the small intestine and mesentery drawn partly upwards and partly to the sides, carbolised sponges, attached to silk, being packed around, if needful, to keep the above structures out of the way. The pulsation of the vessel is now felt for, and the deeper layer of peritonæum carefully scratched through. Care should be taken to disturb as little as possible the aortic plexus† during this step and in passing the needle, which should be carried from right to left.

The ligature used should be one of the flat tape-like ones, of kangaroo tendon or sufficiently stout silk. The passage of the needle may be attended with much difficulty,‡ not only from the depth of the vessel, and from the presence of intestines if distended and allowed to protrude into the wound, but also from the denseness of the cellular tissue surrounding the artery.

B. *Behind the Peritonæum* (Fig. 5).—This method should be tried in any case where the surgeon is unable to take those precautions for which intra-peritonæal surgery calls. The chief objection is the great depth at which the artery is reached; but it is well worthy of notice that in Monteiro's case, which survived ten days, this method was made use of.

The operation is performed on much the same lines as that already given for ligature of the common iliac (p. 17). The incision should be as free as possible, from the tip of the tenth rib, curving somewhat forwards to the anterior superior spine.§ The muscles and transversalis fascia being cut through, the peritonæum is stripped up and turn inwards, several large retractors placed in the wound, and the r dragged up and outwards. The common iliac being found, this ves is traced up into the aorta (Fig. 5).

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* In Mr. James's case (*Med.-Chir. Trans.*, vol. xvi. p. 10) a large quantity of blood was found post-mortem in the abdominal cavity. This had come either from a vessel in the parietes, or from one wounded in the mesentery.

† Sir A. Cooper (*loc. supra cit.*) believed that his experiments on dogs proved that inclusion of this plexus, and not the interruption of the circulation, was the cause of the paralysis which followed the experiment. In Mr. James's case, when the ligature was tightened, the patient complained of "deadness in the lower extremities." This was soon followed by agonising pain in the same parts, only relieved by death about three hours after the operation.

‡ Thus, in Mr. James's case the aneurysm-needle broke at its handle, the surgeon having "little anticipated occasion for so much force." In one case the sac gave way during the operation.

§ If necessary, a horizontal one might be added, at right angles to the first, but the rectus and the deep epigastric should on no account be interfered with.

Treatment by Acupuncture.—This method has been fully alluded at p. 645, vol. i.; and a brilliantly successful case of abdominal aneury treated by Prof. Macewen with needles, and the formation of wh thrombi, will be found at p. 647, vol. i.

Treatment by the Introduction of Wire.—This method has be described at p. 644, vol. i. Prof. Loreta, of Bologna, has applied it to o case of abdominal aneurysm which attracted much attention at the tin but proved, as is so common in these cases, only temporarily successf An account will be found (*Brit. Med. Journ.*, vol. i. 1885, pp. 745, 95 taken from the original paper (*Mem. Roy. Acad. Scien. Institute Bologna*, Feb. 8, 1885).

The patient was a sailor, aged 30, who had always had good health, save i syphilis five years before. Nearly two years before his admission he had felt somethi give way in the belly while making violent efforts. A large aneurysm occupied t epigastric and left hypochondriac regions. An incision having been made from t ensiform cartilage to the umbilicus, numerous superficial adhesions were found, a carefully separated, but it was found impossible thus to deal with deeper ones uniti the sac to the stomach, spleen, and diaphragm. Hence it was impossible to trace t aneurysm to its mouth, nor could it be compressed and emptied. It remained uncertai therefore, at the time, whether the aorta or one of its branches was the vessel involve The vessel, which was now fully exposed on its right side, was punctured with a fi trocar, and silvered copper wire passed in from above downwards and to the left. soon as the wire met resistance the cannula was removed, the end of the wire push in, and the puncture brushed over with pure carbolic acid. A little over two yards ha been introduced. The after-course was one of rapid and progressive recovery. Th man was allowed to get up at the end of six weeks, the swelling having consolidate the bruit having disappeared, the pulsation being only communicated, and the femor pulse, which had been almost suppressed, having reappeared. The patient die suddenly, ninety-two days after the operation, from rupture of the aorta immediatel below the sac at the angle of juncture between this and the aorta. The sac, filled wit organising fibrin, had shrunk to the size of a walnut. The wire was found unaltere and rolled up in a globular mass. Prof. Loreta suggested that the compression pro duced by the coagula in the sac might have caused an interference with the bloo supply to the arterial wall just below the swelling, and so induced rupture of an arter no doubt already diseased.

Treatment by Temporary Compression.—Prof. Keen (*Amer. Journ of Med. Sci.*, Sept. 1900), who publishes a case of ligature of the abdomina aorta just below the diaphragm, the patient surviving forty-eight days has devised an instrument by means of which temporary compression o the aorta may be carried out. The instrument, which is fully describe and figured, consists of a screw clamp in two parts, which is applied directly to the aorta through an opening in the abdominal wall.

Four experiments on dogs are described, the results of which clearly show the feasibility of the plan.

Prof. Keen considers that the instrument might be used either for a short interval under anæsthesia, or might be left *in situ* for two or three days, during which pressure could be applied at intervals.

CHAPTER II.

OPERATIONS ON HERNIA.*

OPERATIONS FOR STRANGULATED HERNIA.—RADICAL CURE OF HERNIA.

OPERATIONS FOR STRANGULATED HERNIA.

Chief Indications for Operation and Points to bear in Mind.—While this is not the place for going into the above fully, a few practical remarks on those indications usually given may be helpful to some of my readers.

i. A lump in one of the openings, more or less hard, tense, and tender, partly or completely irreducible, and with impulse doubtful or absent.

a. The swelling may be small and deep-seated, as in a bubonocele near the internal ring, or a femoral hernia in a fat patient.

b. Two herniæ may be present, both irreducible. The surgeon should operate on the one which is the more tense and has the less impulse, and the one which has the more recently descended. If this fail to give relief, either the opposite swelling must be explored or abdominal section performed in the middle line. This step will probably allow of the opposite hernia being reduced from within, and also of any other possible seats of strangulation being explored—viz., the inner aspects of the deeper rings.

c. As to the impulse, it is worth while to observe carefully the point where this ceases. This, probably, is over the site of stricture, and should be about the centre of the incision.

On this most important point, of impulse, Sir. W. H. Bennett speaks as follows: In a case of strangulated omental inguinal hernia with commencing gangrene of the omentum, there yet was no interference with the action of the bowels, constipation and vomiting were alike entirely absent, but the symptom which conclusively called for operation was the entire absence of real hernial impulse. The following remarks on the detection of impulse are worthy of the most careful attention: "The impulse in ordinary non-strangulated hernia, whether the contents of the sac be omentum or bowel, is *expansile* in character, that is to say, the tumour, when the patient coughs or strains, not only rises under the hand, but expands in size. In hernial tumours c taining bowel this sudden increase in the bulk is principally due the additional quantity of gas, &c., which is suddenly driven into herniated portion of gut by the act of coughing or straining. omental herniæ the expansion is partly due to the sudden turgesce in the omental vessels, and partly to the increase of tension in the due to the cough. Naturally, therefore, the amount of expansion relatively greater in herniæ containing bowel than in those composed omentum. . . . . In strangulated hernia it is important to underst that absence of impulse does not necessarily mean *immobility* duri coughing, for a hernia, even if tightly strangulated, will often m freely under the hand, especially if it be omental. This movement however, rather of the nature of a jump or jerk, and is never expans There is no question which has a more practical bearing upon the tre ment of strangulated hernia than the expansile character of this impul It may be safely held as a surgical dictum, that *every case of hernia which any change has taken place in the condition of the tumour, such increase of size or tension, whilst expansile impulse is absent, should regarded as strangulated.*"

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* The different forms of hernia, those which present on the thigh as well as the inguinal and umbilical varieties, will be considered here for the sake of convenience, and because they are all abdominal in origin.

d. Sir J. Paget (*Clin. Lect.*, p. 108) thus wrote of the *hardness* o hernia:—"In large herniæ the hardness may chiefly be felt at and n the neck and mouth of the sac, especially in inguinal herniæ, and y must take care not to be deceived by a sac which is soft and flac everywhere except at its mouth, for there may be strangulated intesti in the mouth of the sac though the rest contain only soft omentum fluid not sufficient to distend it; nay, you must not let even a who soft condition of the hernia, or an open external ring, weigh do against the well-marked symptoms of strangulation, for the piece intestine at the mouth of the sac may be too small to give a sensati of hardness, or the whole hernia may be omental."

ii. Constipation becoming absolute, even as to flatus.—It is w known that small scybalous motions may be forced out by the straini of a patient with a strangulated hernia, anxious to get his bowels to a Further, and in intestinal obstruction generally, the bubbling away an enema may simulate the passage of flatus. In those rare cas where, other evidence of strangulation being present, the bowels co tinue to act at intervals, it is probable that the constriction of the bow is not complete, and leaves a channel along the mesenteric border. such cases which have been left long, owing to the absence of constipati and perhaps the slightness of the vomiting, the surgeon must exami the bowel very carefully before he returns it. Constriction, though on partial, may have here caused, from its long duration, thinning ulceration of the intestine at one spot, and fæcal extravasation ma take place as soon as the bowel is returned. If there is any reaso for doubt in these cases the stricture should be thoroughly divided an the bowel left *in situ.*

iii. Vomiting.*—Especially if (*a*) this is changing from the earl rejection of stomach contents or bile to fæculent fluid; (*b*) even if it is repeated only at long intervals, and all other signs are absent or little marked; (*c*) it must be remembered that vomiting may be stopped by drugs, strangulation persisting, or the intestines may be empty.

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* Sir J. Paget (*loc. supra cit.*, p. 112) says: "If I were asked which of the signs o strangulation I would most rely on as commanding the operation, I should certaint say the vomiting." Later on (p. 114) he urges that the practitioner should not wait fo any characteristic mode of vomiting, nor be misled by the absence of any particula

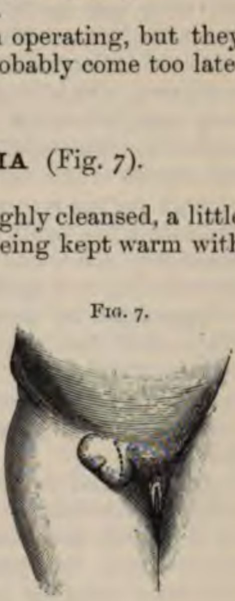
iv. Tympanites and other evidence of peritonitis.

These will not, of course, debar the surgeon from operating, but they will lead him to warn the friends that relief will probably come too late.

STRANGULATED FEMORAL HERNIA (Fig. 7).

Operation.[*]—The parts being shaved and thoroughly cleansed, a little iodoform rubbed in around the genitals, the limbs being kept warm with blankets and a hot bottle or two if the patient's vitality is low, and the knee flexed slightly over a pillow, an incision two and a half to three inches long is made vertically on the inner side of the swelling. Some small branches of the superficial external pudic occasionally require torsion or ligature. The cribriform fascia and the fascia propria (femoral sheath and septum crurale) are next divided in the same vertical line, with or without a director,[†] according to their thickness and the experience of the operator, all the incisions made going quite up to and above the top of the swelling, so as to lie over the seat of strangulation, usually Gimbernat's ligament.

FIG. 7.



In the operation without opening the sac,[‡] the site of stricture must next be found. The varieties here are best given in Sir James Paget's words (*loc. supra cit.*, p. 132): "In some instances, as you trace up the neck of the sac, you find it tightly banded across by a layer of fibrous tissue called Hey's ligament—a layer traceable as a falciform edge of the fascia lata, where that fascia, bounding the upper part of the saphenous opening, is connected with the crural arch, and is thence continued to Gimbernat's ligament. Sometimes a fair division of this

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fluid, nor even by the absence of all vomiting, nor under-estimating the importance of occasional vomiting as a signal for operation.

[*] While general anæsthesia will be preferred in most cases from the more certain loss of sensibility and the relaxation of the parts, a case related by Dr. Mason (*Brit. Med. Journ.*, vol. i. p. 834) shows how valuable cocaine may be as a local anæsthetic. A woman who had suffered from heart disease for many years required operation for a strangulated femoral hernia. Three four-minim injections of a 4 per cent. solution of cocaine were given, the first under the skin over the centre of the tumour, the second above and the third below the tumour, as deeply towards the femoral ring as was thought safe. It was only during actual division of the sac and the insertion of the sutures that any pain was complained of. The wound healed by first intention.

[†] The operator can also manage very well with scissors, keen-edged but blunt-pointed, first nicking each layer, and then separating it from the next with the closed points.

[‡] Cases best suited for this plan are those where the strangulation has been short; its symptoms not very severe—*e.g.*, the vomiting only bilious; where the hernia is small in size [illegible]ut mixed contents; where the patient is in good condition, and any pre[illegible] been gentle and brief.

layer of fibres up to the edge of the crural arch is sufficient to render hernia reducible. . . . . But in more cases this is not sufficient, and may feel the stricture formed by bands of fibres which encircle the ne of the sac, and which must be divided, band by band and layer by lay till none can be felt. These fibres are part of the deep crural ar Very rarely, however, even the division of these is not sufficient, for t stricture is formed by thickening of the mouth of the sac itself. T condition, which is a common cause of stricture in inguinal hernia, very rare in femoral; but it certainly does occur, and in any case w suited for the operation, without opening the sac, you may try to tl the mouth of the sac without opening it, and thus to make it extensil enough for the return of its contents. You may try this, but the chan of success are small. You are much more likely to cut into the sac some thin place, and when you have done this you had better enlar the opening and divide the stricture from within."*

Operation by Opening the Sac.—This, with very few exceptions, the method to be employed. For many reasons it is better and mo satisfactory, and of these the two following, apart from others, w justify its performance in the majority of cases: 1. The importance inspecting the bowel; 2. It renders an attempt at radical cu possible.

In this and in the former case much difficulty is occasionally m with in deciding as to whether the sac is reached or no. The caus of difficulty here are mainly—(1) An altered condition of the s parts from the pressure of a truss, or from long strangulatio (2) from meeting with fluid outside the sac; (3) from the extre thinness of the patient, which leads to the sac being reached u expectedly; (4) from the opposite condition, much fat being met wi in several of the deep layers, making it uncertain which is the extr peritonæal layer, the fat in these cases being often soft, and readi breaking down under examination; (5) an apparently puzzling numb of layers—this condition is usually due to "hair-splitting" ove carefulness on the part of the operator, at other times it is broug about by a much thickened fascia propria separated into imperfe layers by its softened condition or inflammatory matting; (6) by tl absence of a sac.†

Aids in Recognising the Sac in Cases of Difficulty.—Several of tho ordinarily given (Erichsen, *loc. supra cit.*)—*e.g.*, "its rounded and ten appearance, its filamentous character, and the arborescent appearance vessels on its surface"—are, I think, quite fallacious. So, too, wit regard to the escape of fluid from the sac, for this is often dry in femor herniæ, and occasionally fluid is met with before the sac is reached. smooth lining characteristic of its inner surface is more reliable, but th inner surface of the fascia propria is sometimes remarkably smooth. Two points remain which will help to solve the doubt—(*a*) To draw gently down the doubtful structure, whether sac or bowel, and to examine whether it is continuous above and below with the structures of the abdomen and thigh, like the other coverings of the hernia, or whether it has a distinct neck to be traced into the abdominal cavity; (*b*) To see if the point of a Key's director can be insinuated along this last doubtful layer into, and moved within, the peritonæal cavity or no. In a very few cases the surgeon, if still in doubt, incises carefully the suspected layer, and tries if he can pass in a probe and move it from side to side; if this can be done, he is still outside the bowel, not between the peritonæal and muscular coats of intestine.

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* In trying to divide points of stricture outside the sac, attention should be paid the following:—(1) First reaching the sac itself, if possible, by a careful division of a the overlying structures in the vertical incision carried well upwards; (2) carefull drawing down the sac, so as to expose any fibres constricting its neck; (3) gentl insinuating the point of the director under any bands met with.

† A sac is said to be absent in some cases of hernia of the cæcum, and where th patient has been operated on before. This, however, was not the case in three herni containing the cæcum, and in two which had been operated on before, that have com under my care.

The sac being carefully nicked with the scalpel-blade held horizontally at a spot where it can best be pinched up with dissecting-forceps—a matter of much difficulty at times, owing to its tenseness—is slit up on a director, and its contents examined. If omentum first present itself, this is drawn to one side and unravelled, and intestine sought for. This usually takes the form of a small, very tense knuckle, of varying colour and condition. If it will facilitate the manipulations needful for reduction, the omentum may be first dealt with. (1) If this be voluminous and altered in structure, it should be tied,* bit by bit, with reliable chromic gut or silk, and then cut away, the scissors being applied so close to the ligatures as to leave holding-room, but no excess to mortify or slough. After the return of the intestine, the stump is also replaced within the abdomen. (2) If the omentum be small in amount and recently descended, it may be merely returned. (3) In a few rare cases when the omentum is intimately adherent to the sac, and the patient's condition does not admit of delay, the omentum must be left *in situ*. As, however, this course very much interferes with the satisfactory wearing of a truss, and as it is likely to lead to a fresh descent of bowel, it should never be followed if it can be avoided.

Reduction of the Intestine.—As soon as this is exposed, the surgeon examines with the little finger-nail, or a Key's director, the tightness of Gimbernat's ligament. In a few cases reduction may be at once effected by gentle pressure backwards on the bowel with the tip of the little finger. But in the large majority the above site of stricture will need division—a point requiring much carefulness for fear of injuring the intestine or important surrounding structures. If the degree of tightness of the parts admit of it, there is no director so safe and satisfactory as the index or little finger of the left hand passed up to the stricture, and the nail-tip insinuated beneath this, the hernia-knife being introduced along the pulp of the finger (Fig. 8). But there is rarely room for this, and a Key's director† must usually take the place of the finger.

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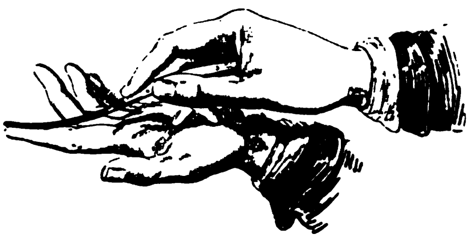
* For security's sake the ligatures should be made to interlock. If hæmorrhage occur from the omentum after it has been replaced, the surgeon must remember that returned omentum generally escapes far from the wound. It will thus be usually needful to extend the wound upwards along the linea semilunaris.

† This director is broad, so as to prevent any intestine curling over and reaching the knife; blunt-pointed, so as not to damage the contents of the peritonæal cavity; finally, its groove does not run quite up to the end, so that the knife-point shall be stopped before it comes in contact with the important parts.

The tip of this instrument being insinuated into the peritonæal cavit just under Gimbernat's ligament, the hernia-knife* is introduced obliquel or flat-wise upon it, its end slipped under and beyond the ligament, it edge turned towards the constricting fibres, and a few of these gentl cut through in an upwar and inward direction. I doing this it is well for th surgeon to draw down th edges of the cut sac clos to its neck, and to ask a assistant to hold these, thu facilitating the passage o the director and the knif by preventing the sac falling into folds before them. Occasionally, also, a knuckle of intestine persistently coils over the edge of the director. This is best met by patience, by drawing it out of the way by the carbolised finger-tip of an assistant, or by pressing it down with the handle of a pair of dissecting-forceps.

FIG. 8.†



(Fergusson.)

The direction and the extent to which the stricture must be cut are matters of much importance. The upward and inward line is the only path of safety. Directly outwards lies the femoral vein; by cutting upwards, the spermatic cord, and, if upwards and outwards, the epigastric artery, would be endangered; behind are the peritonæum and pubes. The incision upwards and inwards must be of the nature of a nick; otherwise, owing to the imperfect healing of the fibrous structure, the ring will be left large and gaping, thus facilitating the re-descent of the hernia, producing much difficulty in fitting trusses, and causing certain discomfort and probable peril to the patient, especially if she belong to the poorer, hospital class.

Gimbernat's ligament having been carefully and sufficiently nicked, the bowel is replaced either by gentle squeezing between the finger and thumb, so as to empty it of its contents, or with the pressure of the little finger; the sac being now kept stretched with forceps so that no folds interfere with the return of the bowel. If pressure on one part of the intestine fail, it must be tried at another point. After the reduction of the intestine the tip of the little finger should be introduced through the crural canal into the peritonæal cavity to ascertain that the gut is absolutely safe; a little sterilised iodoform is then dusted on to the stumps of omentum, and these too returned, if this has not been done.

If the patient's condition and age admit of it, and if the adhesions are not too firm, the sac should next be taken away by carefully separating it with the finger or a director from its attachments. It should then be pulled well forwards, an aseptic finger introduced up to its neck, this part next ligatured with stout silk as high up as possible, the finger then withdrawn, and the sac cut away half an inch below the ligature. If the surgeon is at all doubtful about the safe ligature of any stump of omentum, he should keep this down and transfix it and the neck of the sac with a double silk ligature, the ends of which are afterwards cut short. Sufficient drainage is now provided by a small tube or a bundle of horsehair, and the superficial wound closed. The dressings must be applied with sufficient care to keep the wound secure from obviously close sources of contamination. It is well to place a separate pad of carbolised tow or salicylic wool over the anus and genitals, and to draw the water off before the patient leaves the table. The thigh should not be kept too much flexed, otherwise the escape of discharge from the drainage-tube will be interfered with.

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* A curved one will be found most useful. The cutting blade is usually too broad and the tip too massive. On the other hand, a worn-down blade has been known to break while dividing a tense Gimbernat's ligament. The intestine may thus be wounded, or the fragment of the knife escape into the peritonæal cavity.

† The cutting blade of the knife shown here is needlessly long and unguarded.

The account of an ordinary operation having been given, it remains to consider certain **complications.** These are chiefly :

1. Adhesions of Bowel to the Sac or Omentum.—The treatment of this uncommon complication must vary with (a) the character and position of the adhesions, (β) the condition of the intestines, and (γ) the state of the patient. Owing to the difficulty of fitting on a truss if any of the hernia is left unreduced, every attempt should be made to free the contents by separating the adhesions with the point of a steel director, the finger-nail, or a blunt-pointed bistoury. When near the neck they must always be divided, sufficiently nicked, or stretched. No intestine and omentum still adherent to each other should ever be returned. A few cases remain in which adhesions should be left alone. When gangrene is threatening, but the operator is too short-handed to face resection of the affected intestine, the presence of adhesions, especially about the neck of the sac, is the chief safeguard against extravasation into the peritonæal cavity. In some cases of large hernia, if the patient be much collapsed, so long as any recently descended loop is returned, any long-adherent intestine may be left. And in other cases of collapse from delay of the operation, where there is much difficulty in returning a loop of intestine, especially if this be not in good condition, it may be left, after the stricture has been sufficiently divided.

It occasionally happens in these cases of deeply congested bowel, especially in inguinal hernia, that after an otherwise successful herniotomy the patient passes profuse and bloody stools. This condition may prove fatal. In one or two cases of this kind which have come under my notice the operator was, most unfairly, blamed for having incised the bowel.

Mr. Kough (*Lancet*, Oct. 11, 1884) records a case in which a patient died in collapse two hours after the reduction of a very large scrotal hernia. The pelvic cavity was full of blood-stained serum ; ten feet of intestine were found dark purple in colour, but uninjured. On laying the gut open about a pint and a half of blood escaped.

2. Tightly Constricted or Gangrenous Intestine.—In spite of all that has been taught about the importance of early operations, cases do still occur in which returning the bowel is doubtful or out of the question. In most cases of doubt, as long as the stricture is sufficiently divided and the intestine placed only just within the crural ring (the wound

being left open and the sac not ligatured), the interior of the abdomen is the best place for the intestine. And this is true of congested intestine, however deeply loaded with blood only, as long as there is some shade of red present. But on these points nothing will surpass the advice of Sir J. Paget (*loc. supra cit.*, p. 138): "You are to judge chiefly from the colour and the tenacity. Use your eyes and your fingers; sometimes your nose; very seldom your ears, for what you may be told about time of strangulation, sensations, and the rest is as likely to mislead you as to guide aright. As to colour . . . . I am disposed to say that you may return intestine of any colour short of black, if its texture be good; if it feel tense, elastic, well filled out, and resilient, not collapsed or sticky; and the more the surface of the intestine shines and glistens, the more sure you may be of this rule. When a piece of intestine is thoroughly black, I believe you had better not return it, unless you can be sure that the blackness is wholly from extravasated blood. It may not yet be dead, but it is not likely to recover; and, even if it should not die after being returned, there will be the great risk of its remaining unfit to propel its contents, and helping to bring on death by what appears very frequent—distension and paralysis of the canal above it. But, indeed, utter blackness of strangulated intestine commonly tells of gangrene already; and of this you may be sure if the black textures are lustreless, soft, flaccid or viscid, sticking to the fingers, or looking villous. Intestine in this state should never be returned. Colours about which there can be as little doubt, for signs of gangrene, are white, grey, and green, all dull, lustreless, in blotches or complete over the whole protruded intestine. . . . . Then as to the texture of the intestine: it should be, for safety of return, thin-walled, firm, tense, and elastic, preserving its cylindrical form, smooth, slippery, and glossy. The further the intestine deviates from these characters, the more it loses its gloss and looks villous, the more it feels sticky and is collapsed and out of the cylinder form, the softer and more yielding, the more pulpy, or like wet leather or soaked paper, the less it is fit for return. And when these characters are combined with such bad colours as I have described, the intestine had better be laid open, that its contents may escape externally and do no harm."

In other long-standing cases of femoral hernia the chief stress of the constriction is shown, not on a dying loop of intestine, but in ulceration, partial or nearly ring-like, at the neck of the sac, under the sharp edge of Gimbernat's ligament. Where this condition, owing to the duration of the case, is suspected, the intestine should be very gently drawn down, and, if ulceration be found, laid open. If the mischief be localised, and the adjacent intestine fairly healthy and not fixed, it will be well to stitch it to adjacent parts to prevent it slipping up into the peritonæal cavity.

The treatment of gangrenous intestine in a hernia is fully dealt with, later on, under the heading of Resection of the Intestine. I will only say here, that wherever possible, *i.e.*, in cases where the condition of the patient, and the experience, and help ready to the surgeon's hand, admit of his taking this step, the gangrenous intestine should always be resected. In a few cases where the above conditions are absent, the surgeon must rest content with opening the intestine and leaving it *in situ.* The quickest way will be to draw the whole loop that is damaged outside the peritonæal sac, and keep it in place by a sterilised bougie or glass rod of appropriate size, as in inguinal colotomy (*q. v.*).

It has been much disputed whether, in these cases, when the intestine is unfit to be returned, it is safe or needful to divide the stricture in addition to laying open the intestine. On the one hand, M. Dupuytren, Sir A. Cooper, Mr. Key, and Sir J. E. Erichsen have advocated this step being taken; on the other, Mr. Travers and Sir W. Lawrence were against it. The following words of a very brilliant writer* will probably convince most that this step is not only injurious but unneeded: "The only result of this is that the protecting barrier, which divides the still aseptic peritonæal cavity from the putrid sac, is broken down, and putridity spreads upwards into the abdomen and kills the patient by rapid septicæmic poisoning. Why break down this valuable wall? If it is argued that, unless the stricture is divided, the contents of the bowel cannot escape, then the reply is that experience proves this to be utterly untrue. In a very short time both flatus and fæces find their way out. As everyone knows, the nipping of the gut is not produced by a sudden narrowing of the hernial aperture, but by a swelling of the loop of gut. . . . . When the gut is slit up, its contents are set free, and its inflammatory juices escape, with the result that its swelling goes down, and room enough is soon permitted for wind and fæces to pass, more particularly as the fæces are invariably quite liquid."

3. Wound of Intestine.—This may be due to (*a*) carelessly incising thin, soft parts; (*b*) great difficulty in making out the sac and the intestine in a fat patient, with the parts matted, especially if the light is bad; (*c*) to the intestine being allowed to curl over the edge of the director while the stricture is being divided, or to this being cut with careless freedom, or, lastly, to a loop lying out of sight just above the constriction, and to the hernia-knife coming in contact with this. Any bubbling of flatus or escape of fæces must lead to a careful search for the wound. The operation wound being freely enlarged, the wound in the intestine found, temporarily closed with a Spencer Wells's forceps, and drawn quite out of the abdomen, the intestines around are carefully cleansed and packed out of the way, and protected with tampons of iodoform gauze or flat sponges. When the wound in the intestine is small, it may usually be tied up around a pair of dissecting-forceps with carbolised silk, the ligature not being tied too tightly, and the ends cut short. If the opening be larger, it should be closed by Lembert's suture (*see* Suture of the Intestine). Whichever method is used, the injured part should be replaced just within the peritonæal cavity, and in a severe case the sac should not be taken away or the wound closed. The patient should be kept under the influence of opium, and liquids restricted.

4. Wound of Obturator Artery.—The position of this vessel when it rises by a common trunk with the deep epigastric instead of from the internal iliac, which occurs in two out of every seven (Gray), may bear

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* Sir W. Banks, *Clinical Notes on Two Years' Surgical Work in the Liverpool Royal Infirmary*, p. 96.

a very important relation to the crural ring. In most cases when thu arising abnormally, the artery descends to the obturator foramen clos to the external iliac vein, and therefore on the outer side of the crura ring and out of harm's way. In a small minority of cases the arter in its passage downwards curves along the margin of Gimbernat's ligament, and may now be easily wounded.

The treatment is mainly preventive—*i.e.*, by making the smalles possible nick that will be sufficient into any point of stricture, such a Gimbernat's ligament, a point the importance of which has alread been alluded to (p. 38), and by using a hernia-knife that is not over sharp. If the artery has probably been wounded, the following point are of interest:—(1) The hæmorrhage may not at once follow th wound. It may not make its appearance till the bowel is all reduced or even until a quarter of an hour after the wound has been stitche up. In one case, that of Dupuytren, no hæmorrhage occurred, and th division of the artery was discovered for the first time at the necrops three weeks after the operation. (2) It may occur when the sac ha not been opened. (3) As is shown by Dupuytren's case, it is not necessarily a fatal accident. (4) Very various means have served to arrest the hæmorrhage. (*a*) Pressure, as in the cases of Sir W. Lawrence, Mr. Hey, and Mr. Barker.* This means was successful in two out o the three cases in which it has been employed. It should only be resorted to when the patient's condition does not admit of the wound being enlarged, and the bleeding points found and dealt with by ligature or forci-pressure. When pressure has to be trusted to, it should be efficiently employed by means of tampons of iodoform gauze wrung out of carbolic acid lotion (1 in 20) and secured on silk. (*β*) Ligature of the vessel, usually the proximal end. Of five cases given by Mr. Barker, this was successful in four; it is only stated in one that the distal end was also secured. The ligature had been applied in some cases by continuing the wound upwards; in others by making an incision parallel with Poupart's ligament, as if for tying the external iliac. This step should always be taken when the patient's condition is satisfactory.† In two of Sir W. Lawrence's cases the fainting of the patient appears to have decided the cessation of hæmorrhage. Both of these recovered. (*γ*) In the event of ligature being really impossible, it might be worth while, before taking other steps, to try the application of a pair of Spencer Wells's forceps. These should be left *in situ* for three or four days, and would favour drainage.

5. Herniæ with Unusual Contents.—These may be (*a*) Fat herniæ. Both in the inguinal and femoral regions, but especially in the latter, the extra-peritonæal tissue near the rings may become increasingly fatty. Gradually projecting towards the surface, it drags down the peritonæum to which it is loosely connected. I have operated on one

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* *Clin. Soc. Trans.*, vol. xi. p. 180. This paper will well repay perusal. Most of the above information is taken from it.

† Mr. Hulke (*Lancet*, 1885, vol. i. p. 746), by freely opening up the wound and using large retractors, found a comparatively large atheromatous artery spouting freely. From its position this was a large communicating artery between the deep epigastric and obturator, lying just behind Gimbernat's ligament. Both ends were secured with very great difficulty. The patient did well.

such case in a girl, aged 19, in whom the fitting of a truss was unsatisfactory. Here I expected to find an omental hernia. Into the pouch so formed intestine or omentum may present. In other cases, if the extra-peritonæal fat thus protruded become absorbed, the hollow thus left may produce a space for the peritonæum to project into. (β) Hernia of the ovary. This is much more commonly met with in inguinal herniæ. The chief points in the diagnosis of these difficult cases are the characteristic oval shape and size of the swelling; the peculiar sickening pain when the swelling is pressed upon; the swelling being larger and the tenderness greater during menstruation; the swelling may sometimes be made to move when the uterus is displaced laterally with a vulsellum, and the ovary of that side is not to be made out *per vaginam*. Where other treatment has failed, where the swelling is irreducible and prevents the fitting of a truss, where the symptoms are sufficiently urgent to cripple a young life, the displaced ovary should be removed. The operation should be rigidly aseptic. Adhesions are not uncommon. (γ) Hernia of vermiform appendix.

I met with a case of this early in 1890, in a lady, aged 43, a patient of Dr. Fraser's, of Romford. The femoral hernia was here irreducible, dull, gave a feel of omentum, and curved upwards and outwards in the usual way. As no truss was satisfactory, and as the patient, the wife of a missionary, was to be much abroad, a radical cure was advised. The sac contained much fluid, but no omentum. In the outer part of the hernia lay a thick fleshy body, tubular and expanded at its end. Near Gimbernat's ligament it was constricted and distinctly abraded. After notching the above ligament, this body, which proved to be the appendix, was easily returned. The sac was removed. The case did excellently.

In another case I should remove the appendix if there were time for making the necessary suturing secure. (δ) Hernia with more than one sac. This may be due to the presence of membrane, inflammatory in origin, which has divided the original sac.

Causes of Herniæ not doing well after the Operation.—(1) Peritonitis, usually from the operation being performed too late. (2) Enteritis. This may be told by the tympanites, tenderness and vomiting being much less marked, and often the presence of diarrhœa. (3) Septic trouble, erysipelas. The eight following are the causes of intestinal obstruction after operations for hernia: (4) The descent and re-strangulation of the bowel. (5) So much damage to the intestine that it lies paralysed in the peritonæal cavity.* (6) Cicatricial stricture of the intestine. (7) Fixing of the bowel, after its reduction, by adhesions to the abdominal wall.† (8) Formation of a band out of the above adhesions. (9) Fixing of the two ends of a loop of intestine by adhesions. (10) Formation of an omental band in the neighbourhood of one of the hernial orifices, a band so formed causing obstruction later (*Brit. Med. Journ.*, 1879, vol. ii. p. 491). (11) A very rare condition. The sac may be multilocular; when the intestine is reduced it may be returned into one of these cavities instead of within the abdomen. Mr. Bellamy has published such a case (*Lancet*, 1886, vol. ii. p. 433). A good illustration of this is given in Mr. Holme *Surgery*, p. 698, Fig. 322; the patient here died eight days aft an operation for strangulated hernia.

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* I have recorded (*Brit. Med. Journ.*, 1879, vol. ii. p. 491) an instance of this in which, ten days after an operation for intestinal obstruction by bands, death took place from the intestine never having recovered itself.

† This and the next three are given by Mr. Treves, *Lancet*, 1884, vol. i. p. 1022.

STRANGULATED INGUINAL HERNIA (Figs. 9 and 10).

Operation.—In considering this it will not be needful to go aga into detail, as in the case of Strangulated Femoral Hernia; the chi points of difference and those of importance will be considered carefull The parts being shaved and cleansed, and the thigh a little flexe an incision four inches long at first is made in the long axis of t tumour, with its centre (in an ordinary scrotal case*) over the extern abdominal ring. This incision may be made either by pinching up fold and cutting from within outwards, or by cutting, in the usual wa from without inwards. The pressure-forceps may be left on the extern pudics (both superior and inferior), these vessels being finally closed b the sutures which unite the wound. As the layers are divided, th knife being kept strictly in the same line throughout, some archin fibres of the inter-columnar fascia may be seen above, but the first laye usually recognised is the cremasteric fascia, often much thickened After this the transversalis fascia, also much thickened and vascular looking, is slit up, and any extra-peritonæal fat overlying the greyish blue sac looked for. The surgeon now sees if he can find any constrictin fibres outside the sac, and slits them up on a director. The mor voluminous the hernia the more important it is to avoid exposur and manipulation of its contents by opening the sac.† But in th majority of inguinal herniæ the surgeon must be prepared for openin the sac. As soon as this is done, with the precautions already give (p. 37), the contents are examined, omentum got rid of if this ste will give more room, and the site of stricture found with the finger-nail or tip of the director. It is next divided with the hernia-knif manipulated under it in a direction straight upwards, so as to li parallel with the deep epigastric, whichever side of the hernia thi vessel occupies.‡ During this stage the steps given at p. 38 must be taken to avoid any injury to the intestine. The constricting point being divided and dilated, the next step is **reduction of the intestine.** This, in bulky inguinal herniæ, is often a matter of difficulty and time. The **chief causes of difficulty here** are—(1) A large amount of intestine, one or two coils of small and some large intestine being not very uncommon. (2) The distension of these with flatus, &c. (3) Insufficient division of the stricture; or there may be a point of stricture higher up than the one divided, and overlooked. (4) During attempts at reduction one bit of intestine may get jammed across the ring instead of slipping up along it, and against this the rest of the contents are fruitlessly pressed. (5) Folds of the sac may in much the same way block the opening.

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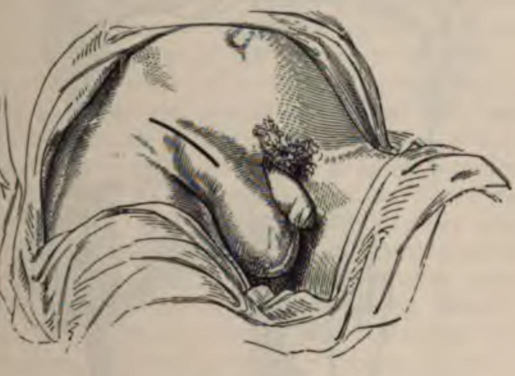
* In a strangulated bubonocele the centre of the incision should lie over the internal abdominal ring, and in the deeper part of the incision the deep epigastric must be felt for, and avoided.

† The site of the stricture in inguinal hernia varies. In both varieties, in old cases of long duration, it is usually situated in the neck of the sac itself, owing to contraction and thickening of this and the extra-peritonæal tissue. In other cases of oblique hernia the stricture is found in the infundibuliform fascia at the internal ring, just below the edge of the internal oblique in the canal, or at the external ring. In a direct hernia the constricting point, if not in the sac, is probably caused by the fibres of the conjoined tendon. In many cases the parts are so approximated and altered that in the short time given for an operation it is not so easy to tell exactly in what tissues lie the strangulation, as to relieve it. Finally, in many cases of young subjects and acute strangulation, muscular spasm—*e.g.*, of the internal oblique—must be borne in mind.

‡ Of course, if the surgeon is certain that he is dealing with an oblique hernia, he may cut outwards, and, in the case of a direct hernia, inwards, so as to avoid the deep epigastric. In all cases the cut should be of the nature of a nick dividing only those fibres which actually constrict, any additional dilatation being usually now effected by the tip of the director or finger.

Aids in Difficult Cases.—First, that part which lies nearest the ring should be taken—*e.g.*, mesentery before intestine. After each part is got up, pressure should be made on it for a few seconds before another is taken in hand. If the surgeon find, after a while, that he is making no progress with one end of a coil, he should take in hand the other end, or another coil altogether if more than one be present. Much of the difficulty met with in the reduction of the intestine is due to the surgeon not first unravelling the coil or coils, not duly tracing up the intestine to the ring so as to make out the relations of the two, and, above all, to his not making up his mind which end of the coil it is exactly which he intends to begin reducing. During the manipulations the thigh should be flexed and rotated a little inwards, and the cut edges of the sac drawn tense with forceps, so as to prevent any folding or pushing up of this before the intestine. If the intestines are much distended, attempts should be made to return some of their contents first into the abdominal cavity. If, after gentle squeezing with the finger and thumb, and careful pressure upwards on each successive bit of intestine, it all appears to be returned, the little finger must be passed into the abdominal cavity to make certain that no knuckle remains in the canal or internal ring.

Fig. 9.

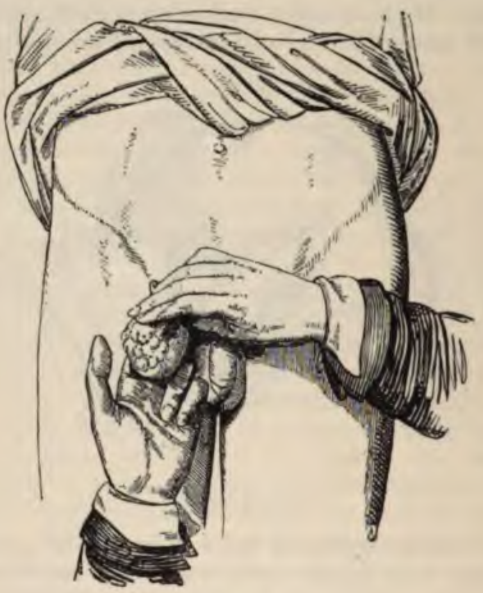


(Fergusson.)

Another Method.—In the case of large scrotal herniæ, where opening the sac in the ordinary way involves much exposure of peritonæal surfaces, I believe the following to be preferable: A small opening, just large enough to admit the left index finger (previously rendered asepti is made in the sac just below the seat of constriction. This is th divided on the finger as a director, *from without inwards*. The s should not be again *opened* here, but after all the constricting bands ha been felt and perhaps heard to give way, the finger easily dilates t communication with the peritonæal cavity and then reduces the conten of the sac. I have used this method twice, and with excellent result It reduces the necessary disturbance of peritonæal surfaces to a minimu Where from long strangulation or the acuteness of the symptoms it advisable to inspect the contents of the sac, or where these are adheren the sac must be more freely opened.

Cases will occasionally be met with, where, owing to the low conditi of the patient, the large amount of intestine down, its great distensio its altered condition, still red and only congested, but softened, with th peritonæal coat shaggy rather than lustrous, and tending to tear easily, i is clear that reduction will not be effected by manipulation only. If th distension is due to flatus, punctures may safely be made with a very fin hydrocele trocar. Where fluid fæcal matter is present the above step i dangerous, and a small incision, carefully closed by Lembert's sutures, the inversion being thoroughly carried out, will give the best results. Where the intestine is much congested and softened, though not yet gangrenous, or where the surgeon has not skilled assistance and all the aids of modern surgery ready to his hand, he had better leave the intestine in the sac after a free division of the stricture.* This method, while

FIG. 10.



(Skey.)

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* This will all gradually and slowly return into the peritonæal cavity. On this point the following case by South (Chelius's *Surgery*, vol. ii. p. 40) is of interest :—" I know by

under the above conditions the safer, prevents, of course, any attempt at relieving the patient, at one operation, by a radical cure.

During any prolonged manipulation of the intestines these should be kept covered as much as possible by iodoform or plain sterile gauze wrung out of hot normal saline solution. It is wise also that the patient should be well under the anæsthetic now, and breathing quietly. If vomiting occur, the surgeon must wait, keeping up pressure on what he has reduced. When the intestine is all reduced, any ligatured stumps of omentum are returned, and, if the condition of the patient admit of it, the sac is detached, one of the methods of radical cure given at pp. 63 to 79 made use of, the precautions as to the cord and other points given at p. 62 being carefully followed.

In this, as in other operations, the wound should be carefully sponged with mercury perchloride solution (1 in 4000), and left exposed as little as possible, especially the parts near the opening into the peritonæum.

In providing drainage after an operation on a large inguinal hernia, where the parts have been much handled either before or during the operation, it is well worth while to bring the lower end of a drainage-tube out at the lower part of the freshly sterilised scrotum, by means of a counter-puncture there, thus ensuring efficient escape of the discharges, and syringing out of the wound if needful.

After thus considering the chief points in the operation, it remains to draw attention to **some special points connected with inguinal hernia.**

I. *Varieties.*—In addition to the oblique and direct varieties, both of which are acquired, there are some others of much practical importance —*e.g.*, (*a*) The congenital. The tubular process of peritonæum is open from abdomen to fundus scroti, and the contents lie in contact with the testis. (*b*) Hernia into the funicular process of peritonæum. Here the tubular process of peritonæum is divided into a shut vaginal sac below and an open funicular process above. Into the latter the contents descend, but are not in absolute contact with the testis. (*c*) Hour-glass contraction of the sac. Here the tubular process is open as in (*a*), but an attempt at closure has brought about a constriction which may be at the external abdominal ring or lower down in the scrotum. If the contents pass through this constriction, and get low enough, they will be in actual contact with the testis. (*d*) Encysted hernia of the tunica vaginalis. Here the funicular process is closed at its upper extremity—*i.e.*, at either ring or in the canal—and open below to the testicle. The hernial protrusion as it comes down either ruptures this septum (when of sudden descent), or gradually inverts it, or comes down behind it. These

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experience that if strangulation be relieved, it is of little consequence how much intestine be down. In reference to this point, I recollect the largest scrotal rupture on which I have operated, and in which, before the division of the stricture, there was at least half a yard of bowel down, filled with air; and, after the stricture had been cut through, at least as much more thrust through, so that I almost despaired of getting any back; yet, after a time, I returned the whole. To my vexation, however, next morning I found that my patient had got out of bed to relieve himself on the chamber-pot, and, as might be expected, the bowel had descended, and in such quantity that the scrotum was at least as big as a quart pot, and the vermicular motion of the intestine was distinctly seen through the stretched skin. Nothing further was done than to keep the tumour raised to the level of the abdominal ring, and by degrees it returned, and the patient never had an untoward symptom."

cases are rare, but may be puzzling when they occur, as the operator h more than one layer of peritonæum to incise before reaching the conten

That the above varieties have an importance beyond that of anatomi puzzles is shown by the fact that in (*b*), (*c*), and (*d*) strangulation m be very acute and urgent. Again, though the defect is a congenital o the hernia does not, in many cases, make its appearance till the patie has, in early adult life, been subjected to some sudden strain. Finall in these cases any prolongation of the taxis will be not only futile, b actually dangerous, owing to the tightness of the strangulation and t facility with which, from the delicacy of its adhesions, the sac may separated or burst.

II. *Reduction en Masse, and Allied Conditions.*—These have bee chiefly met with in inguinal herniæ owing to the loose connections the sac and, sometimes, to the force used in attempts at reducing lar specimens. Strangulation may persist after (*a*) displacement, or (rupture of the sac. In the former, the sac, still strangling its conten at its neck, is displaced bodily between the peritonæum, usually, an extra-peritonæal fascia. In the latter the sac is rent, usually close its neck and at its posterior aspect, and some of its contents are thru through into the extra-peritonæal connective tissue. The chief evidenc of these accidents is: though the swelling has disappeared, perha completely, this has taken place without the characteristic jerk gurgle. On close examination, though the bulk of the hernia is gon some swelling, often tender, is usually to be made out, deep down, in th neighbourhood of the internal ring. Above all, the symptoms persis perhaps in an intensified form.

The treatment is immediate exploration of the inguinal canal and th internal ring. If the cord is exposed, the whole sac has probably bee detached. If any of the sac is left above, a rent in it should be sough for. Supposing the index finger, passed through the internal ring, fai to find any swelling, aided by pressure from above, a vertical incisio must be added to the upper end of the oblique one, and the neighbourhood of the internal ring explored.*

III. *Retained Testis simulating Hernia.*—Such a testis, when inflamed may closely simulate strangulated hernia. A testis, perhaps, has neve descended; a truss has been worn and laid aside. The patient present himself with a tender swelling in one groin, with indistinct impulse The abdomen is tense and full, constipation is present, and perhap vomiting of bilious fluid. Such a swelling should be explored and th testis removed, as it is certain, later on, to cause serious trouble, even i the present urgent symptoms subside with palliative treatment. In other cases a retained testis may draw down an adherent loop of intestine which may become actually strangled.†

STRANGULATED UMBILICAL HERNIA.

Two distinct forms of strangulated hernia will be met with here. One, more rare, is of small size, with a single knuckle of intestine acutely strangled in the navel-cicatrix. The other, the more common, is often huge, its contents mixed, intestine both large and small, and omentum. Such herniæ soon become, in part at least, irreducible; when in this condition, any unwise meal may readily bring about obstruction, a condition requiring much care to tell from strangulation.* In other cases a large irreducible hernia may easily become strangulated from the descent of some additional loop of bowel. The adequate fitting of a truss is often a matter of much difficulty here, owing to the large size of the abdomen, the presence of adherent omentum, and, frequently, of an habitual cough.

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* As this will probably involve abdominal section, the steps given later should be referred to.

† For fuller information on these matters I would refer my readers to *The Diseases of the Male Organs of Generation*, chapter ii. p. 72.

Practical Points before Operation.—(α) The sac usually communicates directly with the general peritonæal cavity by a large opening. (β) The contents are not only mixed, but of long standing, and often adherent. (γ) The patients are often advanced in life, obese, flabby, and not infrequently the subjects of chronic bronchitis. (δ) The coverings are ill nourished and slough easily.

Operation.—In view of the delicacy of the skin and the intertrigo which is often present, the cleansing must be thorough but gentle. An anæsthetic having been administered, an incision two to three inches long is made over the lower† part of the swelling in the middle line, the hernia being pushed upwards to facilitate this.‡ The thinness of the coverings must be remembered. Search should be made for any constricting bands of fibres outside the sac. If it be needful, the sac must be opened, with the knife held horizontally, and slit up, care being taken now and throughout the operation, in cases of large herniæ, that protrusion of intestine be prevented by the means given a little later. The contents having been examined, any intestine is gently displaced upwards, while the surgeon turns the curved surface of a Key's director over the lower edge of the opening, and, guiding the hernia-knife on this, divides the constricting edge downwards. If sufficient space is not given, the downward nick may be repeated, or the director turned against the lateral or upper aspects of the ring, and fibres here also divided.

Adhesions of the contents of the sac are not infrequently met with.

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* Amongst the most important points will be the vomiting, whether early in onset, constant, and showing signs of becoming fæculent, and the constipation, whether absolute, even to the passage of flatus. In doubtful cases the rule should be to operate. "The risk of operating on a hernia which is inflamed and not easily reducible is very small in comparison with the risk of leaving one which is inflamed and strangulated; and even if you can find reasons for waiting it must be with the most constant oversight, for an inflamed and irreducible hernia may at any time become strangulated, and will certainly do so if not relieved by rest and other appropriate treatment" (Sir J. Paget, *loc. supra cit.*, p. 106).

† The lower part is here recommended because, in Mr. Wood's words (*Intern. Encycl. of Surg.*, vol. v. p. 1165), "the point of strangulation in an adult umbilical hernia is most frequently at the lower part of the neck of the sac, where the action of gravity, the dragging weight of the contents, and the superincumbent fat, together with the pressure and weight of the dress or an abdominal belt, combine to press downwards upon the sharp edge of the abdominal opening. It is here that adhesions and ulceration of the bowel are most frequently found, and here the surgeon must search for the constriction in cases of strangulation." An incision here also gives better drainage.

‡ If the surgeon intends to attempt a radical cure, and if the skin is diseased, much thickened with old abrasions, he should remove this area by two elliptical incisions.

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If they are very close and dense, and if the condition of the patient unsatisfactory, and if the surgeon be short-handed, he should be co tent with a free division at one or two places of the constricting rin and with reducing any portion of intestine that has clearly only recent come down, and leave the rest undisturbed.

A complication of large umbilical herniæ is thus well described l Mr. Wood (*loc. supra cit.*, p. 1168):

"In corpulent persons, in whom the operation has been delayed un peritonitis has begun, the operator has frequently to contend with a ru of bowels out of the abdomen. This should be restrained by receivi them in warm towels* wet with carbolic lotion, and applying pressu by the hands of assistants. If it can be managed, all the operati proceedings within the sac should be done before such a rush occur but if a cough, or vomiting, or anæsthetic difficulty occurs at th juncture, this is sometimes impossible, and the surgeon is compelled do the best he can. In such cases the operation becomes a formidab one indeed, and is comparable only to laparotomy under conditions distension of the intestines. The bowels and omentum should alway if possible, be kept in the warm wet towels, and not indiscriminatel handled by the assistants, whose arms should be bared and well purifie with carbolised lotion. The intestines should always be returned befor the omentum, which should, if possible, be spread out† over them befor the stitches are applied."

All the intestine and the remains of the omentum, carefully ligature having been returned if possible, the surgeon now, if the patient's con dition admits of it, removes the redundant sac and skin. The openin into the abdominal cavity is closed in the following manner:—The sa is carefully separated all round till its neck is cleared, the redundan part is cut away, and the peritonæum closed by means of a continuou suture of fine silk. The edges of the ring are now drawn firmly togethe in the same way by means of a continuous silk suture;‡ and, finally the skin edges are united with horsehair or fishing-gut.

It will be seen from the above account that three methods may b pursued in the reduction of a strangulated umbilical hernia: (1) Th division of the stricture outside the sac (p. 35). Where the surgeon i short-handed, this should always be tried, but is rarely successful here. (2) If the sac has to be opened, the opening is made as small as possible, and the ring freely divided at one or two points, but the contents disturbed as little as possible, any recently-descended intestine being returned, but thickened omentum and adherent intestine (especially large) being left undisturbed. (3) Free opening of the sac, examination and separation of its contents, return of all intestine, and of omentum after ligature and resection.

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* Large squares of iodoform gauze wrung out of hot sterile salt solution are to be preferred.

† Mr. Wood prefers leaving the edge of the omentum so arranged as to become adherent to the lower margin of the hernial opening, so as to prevent, if possible, any future protrusion, to tying it and cutting it short.

‡ Mr. Barker (*Brit. Med. Journ.*, 1885, vol. ii. p. 1101) advises the use of a double row of sutures—the first as given above, to unite the edges of the ring; the second, to give extra strength to the scar, are passed through the anterior layer of the sheath of the rectus on each side, at about one-third of an inch from the edge of the ring. On these being brought together, a considerable fold of fibrous tissue is inverted and brought into contact in the middle line, over the first row which closed the ring.

While the third of these courses has the great advantage of leaving the patient permanently in a more satisfactory condition, as it admits of something like a radical cure,* the surgeon can only rightly decide between this and the second course by a careful consideration of each case. The following points may aid in judiciously selecting either operation:—(1) The size, long standing, previous attacks of incarceration and obstruction of the hernia, all these tending to bring about adhesions and alterations in the parts. (2) The condition of the patient—viz., the degree of flabby fatness, chronic bronchitis, probable renal and hepatic disease, amount of depression by vomiting and pain. (3) The facilities for carrying out, during the operation and later, strict antiseptic precautions. (4) The presence of the skilled help so essential in these cases. (5) The way in which the anæsthetic is taken. (6) The amount of experience of the operator. Thus a hospital surgeon, frequently operating and with all instruments and assistance at hand, may readily incline to one course, while the other may as wisely be followed by a surgeon who has to operate under very different circumstances.†

STRANGULATED OBTURATOR HERNIA.

This form of hernia has occurred too frequently to be entirely passed over. It may be so readily and fatally overlooked that a few words on its *diagnosis* will not be out of place.

(1) Position of the swelling. This appears in the thigh below the horizontal ramus of the pubes, behind and just inside the femoral vessels, behind the pectineus, and outside the adductor longus. (2) On careful comparison of the outline of Scarpa's triangles, a slight fulness is found in one as compared with the hollow in the other. (3) Pain along the course of the obturator nerve, down the inner side of the thigh, knee, and leg. (4) Persistence of symptoms of strangulation, the other rings being empty or occupied by reducible hernia. (5) A vaginal or rectal examination.

Operation.—Two different ones present themselves: (i.) by cutting down on the sac, as in other herniæ; (ii.) by abdominal section, and withdrawing the loop from within.

(i.) The parts having been duly cleansed and slightly relaxed, an incision is made parallel to and just inside the femoral vein.‡ The saphenous opening being probably exposed in part, the fascia over pectineus and the fibres of this muscle having been divided transvers for one and a half or two inches, the obturator muscle covered by fascia and some fatty cellular tissue is next defined, and the hernial probably now comes into view, either between the muscle and pubes, or between the fibres of the muscle. If the case is a recent o attempts are now made to reduce the hernia without opening the s If the sac has to be opened, and any constriction divided, the kn should be turned either upwards or downwards, the latter being t easier if any constricting fibres intervene between the sac and t bone. As the obturator vessels lie usually on one side or the oth a lateral incision must be avoided.

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* It will be remembered that it is not so essential to try and ensure a radical cure in the usual subjects of umbilical hernia as in children and young male adults, with the prospect of a long and active life before them.

† Mr. Clement Lucas (*Clin. Soc. Trans.*, vol. xix. p. 5) advocated more radical measures, such as excision of the sac and redundant skin, with suture of the ring, in all cases of umbilical hernia. Two successful cases are recorded, both excellent instances of this treatment, and one of especial interest, as the patient had been previously thrice tapped for ascites, and the operation allowed three pints and a half of fluid to escape.

‡ Mr. Birkett (*loc. supra cit.*, p. 830) says the incision "may commence a little above Poupart's ligament, at a point midway between the spine of the pubes and the spot where the femoral artery passes over the ramus of that bone."

Care must be taken to keep the femoral vessels drawn outward witl retractor, while any branches of the obturator or anterior crural ner are drawn aside with a blunt hook, the same precaution being tak with the saphena vein.

When by the passage of the little finger into the abdomen it certain that the intestine is reduced, if the condition of the patie admits of it, the sac is separated and ligatured close to the thyro foramen and removed. Drainage must be provided with aseptic horseha or a fine tube.

(ii.) The operation of abdominal section will, perhaps, be more fr quently performed in the future.

An obturator hernia was thus reduced by Mr. Hilton in a case which simulat intestinal obstruction. Some empty intestine being found and traced downwards, l to the detection of an obturator hernia, which was reduced by gentle traction aided firm pressure made deeply in the thigh. The patient, who was not operated on till t eleventh day, died of rapid peritonitis.

Sir J. E. Erichsen briefly mentions a case operated on by this means in 1884 by M Godlee. The hernia was reduced without difficulty, but the patient, who was mu collapsed at the time, died in about twenty-four hours.

Question of the advisability of reducing Strangulated Hernia b Abdominal Section.

This question having arisen here may be dealt with once for al Cases will occur from time to time, such as Mr. Hilton's (*loc. supra cit.* in which, evidence of acute intestinal strangulation existing and n hernia being detected externally, on the abdomen being opened th cause will be found to be a piece of a small intestine nipped in part o its circumference, probably in either one of the femoral or obturato rings. Still more rarely, a surgeon may find such difficulty in reducin an obturator hernia from without, that he feels himself driven to resor to abdominal section. In such a case an incision should be made along the corresponding linea semilunaris, and brought as low down as possible When the abdomen is opened, if there is any difficulty in withdrawing the gut, the intestines should be pushed upwards out of the pelvis, and the neighbourhood of the ring shut off with sponges or iodoform gauze tampons, while the condition of the strangled loop is inspected, and this either reduced, or treated by resection, or by the making of an artificial anus, according to the condition of the patient and the surroundings of the operator. Some years ago it was suggested that it should be the rule to reduce herniæ, and perform the radical cure by abdominal section. Thus, at the meeting of the British Medical Association in 1891 (*Brit.*

Med. Journ., Sept. 26, 1891), this question was discussed, the late Mr. Lawson Tait introducing the subject. As might be expected, the proposal to abandon the old operation and treatment by median abdominal section met with no support from those surgeons who know anything of operations for strangulated hernia in hospital practice, especially in males. Save in the rarest cases, such as those belonging to the category I have mentioned, such a step is to be condemned in the strongest terms, for the following reasons: (1) Operations for relief of strangulated hernia must sometimes be performed by general practitioners. The old and well-established operation is one, *per se*, of but slight severity, and one that usually can be kept extra-peritonæal by an operator of ordinary skill and of average anatomical knowledge. Those who would substitute abdominal section forget that, however safe they may consider themselves, with their especial experience, to be in preventing *peritonitis*—a very different standpoint from that of a general practitioner—neither they nor anyone else can prevent the *shock* which goes with intra-peritonæal operations, a complication which is certainly to be avoided in patients exhausted by a strangulated hernia. (2) The reduction of the intestine which is spoken of as so easy after abdominal section by those who advocate this method, is liable to be prevented by adhesions to the sac, &c.; when such exist—and no one can foretell this point—the sac must be explored in the usual way. (3) There is a very grave risk that the intestine is tightly nipped, and often may give way when pulled upon through a median incision. Those who advocate abdominal section will say that the resulting extravasation can be met by flushing, &c. It will be well for all such to remember the following advice, tersely put by Sir W. Bennett (*Clin. Lect. on Hernia*, p. 122): "Let it be noted that it is generally far more easy to *soil* the peritonæum than to *cleanse* it." The same surgeon points out (*ibidem*, p. 121) that the fluid found in the sac of herniæ, when strangulation has long existed, is sometimes dark and ill-smelling, though no lesion may be apparent in the gut itself. By an ordinary herniotomy such fluid is thoroughly drained away from the peritonæal cavity, and any such intestine is cleansed before it is put back, or otherwise appropriately dealt with. (4) All operating surgeons are agreed that, whenever the condition of the patient admits of it, an operation for strangulated hernia should be completed by giving the patient at least a chance of radical cure. I am distinctly of opinion that no intra-peritonæal operation yet described will secure radical results in inguinal herniæ. (5) Those who think they are improving matters by substituting abdominal section for the old-established herniotomy, object to the latter on account of its tendency to weaken the abdominal wall by the incision made to reach and relieve the constriction. Such advocates forget the criticism pithily put forward during the above discussion by Mr. Keetley, that treatment of herniæ by abdominal section created two potential hernial apertures where there was originally but one.

RADICAL CURE OF HERNIA.

Before describing the different methods, the following points claim attention; and while the improvements of modern surgery have established radical cure on a sound scientific basis, many questi ain still undecided. The chief of these are: (1) The justifiability of operation. (2) The use of the terms "radical cure" and "permane of the cure." (3) The earliest age at which the operation is advisa in children. (4) The advisability or need of wearing a truss afterwa (5) The best material for suture. (6) The best form of operation.

(1) **The Justifiability of the Operation.**—Before we can answer t in the affirmative we must be able to honestly feel that the operatio safe, (*a*) *as regards the patient's life*, (*β*) *as regards the testicle.* O those surgeons who have had experience in operating, who thoroughly acquainted with the needs of modern surgery, and who pay the needful attention to every detail, can promise the above safe

(*a*) *The safety of the patient's life.*—The following recent statis show what modern surgery and experienced hands can do. Drs. E and Coley (*Annals of Surgery*, vol. xxviii., 1898, p. 604) have compi a list of 8594 cases under the care, be it noted, of well-known operat with seventy-eight deaths, giving the very low mortality rate of ·9 cent.

(*β*) *The safety of the testicle.*—This is dealt with at p. 62.

(2) **The Value of the Term "Radical Cure," and the Permane of the Cure after Operation.**—Present results give the promise great improvement here. A few years ago some of the best authorit were not using the term "radical." Thus, Sir W. M. Banks,* one the earliest and foremost workers on the subject, and a writer who l given his results with honest frankness, considers the term radical c "misleading. It is popularly understood that a patient upon wh the radical cure has been performed need never again wear a truss ever again be in danger of his hernia coming down. This is, unf tunately, far from being the case. The instances in which a lig truss can be dispensed with are in the minority." A few years la (*Brit. Med. Journ.*, 1893, vol. ii. p. 1044) he wrote somewhat more ho fully. Of 168 cases he had traced for very considerable periods 11 "of these 79 remain quite sound, 19 are partial successes, and are complete failures." In America—where, as with oöphorectomy a removal of the appendix, this operation has been resorted to more fre than in this country—warnings have been given by some of the be known surgeons that the use of the term "radical cure" may be p mature. Amongst the chief of these has been Dr. W. T. Bull,† Surge to the Hospital for the Ruptured and Crippled, of New York. Dr. B has collected 137 cases operated on for radical cure in which a relap had taken place, and he adds that these relapsed cases "probab represent but a small proportion of those operated on."

Mr. Macready, Surgeon to the City of London Truss Society, writ the following weighty words on what he calls the unsatisfactory natu of the evidence as to efficacy of the radical cure (*A Treatise on Ruptur* p. 234): "The evidence brought forward by one surgeon after anoth in favour of these operations is always of the same character. A numb of cases are given in which the operation has been performed, and which the result has been watched for periods varying usually from few months to four or five years. Very few cases are under observation so long as five years; for the patient changes his residence or declines to show himself. M. Terrier on one occasion wrote to twenty-five old patients, and received only two replies. It must not be supposed that a patient is cured because he does not come for inspection. The relapsed cases at the Truss Society have almost all been asked if they have visited the operator to show him the result. In the great majority of cases they prefer not to go back, and very often, alas! express themselves as if a deception had been practised upon them. It is much to be regretted that patients should feel this reluctance to face the operator again, for in consequence the surgeon is apt to form too favourable an opinion of the efficacy of his plan. Sometimes a patient, after remaining cured for a number of years, passes from under observation and again becomes ruptured. . . . . All that we can say of the operations, involving complete removal of the sac, is that they all give immunity to a certain number for a certain time."

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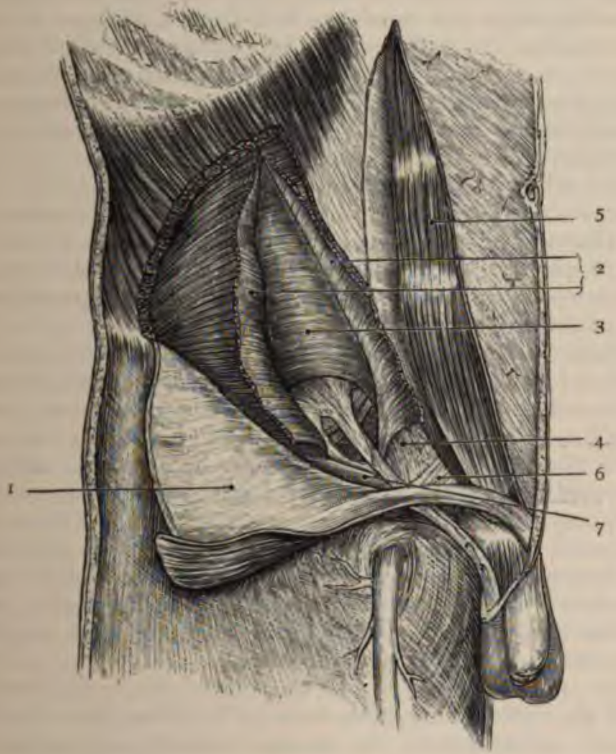
* Pamphlet; *Med. Times and Gaz.*, 1884; *Brit. Med. Journ.*, Dec. 10, 1887.

† *N. Y. Med. Journ.*, May 30, 1891; *Med. News*, 1890; *Annals of Surgery*, 1893. vol. p. 534 *et seq.*

FIG. 11.



Dissection of inguinal canal.
1, External oblique turned down. 2, Internal oblique. 3, Transversalis.
4, Conjoined tendon. 5, Rectus abdominis with its sheath opened.
6, Triangular fascia. 7, Cremaster. (Heath.)

While opinions like the above, candidly expressed by operators of wide experience, will carry special weight with all thoughtful surgeons, it i probable that the work of the last few years, and still more that of th coming decade, will place the radical cure of hernia on a firmer an more satisfactory basis.

We are now learning more distinctly the principles on which thi operation is to be conducted. Two or three methods have now bee employed on such a large scale, and with such excellent results, that i seems probable that a permanent cure can be promised in a large numbe of favourable cases. This qualified statement requires explanation. B a "permanent cure," I mean a cure which will last a lifetime. B "favourable cases," I mean children, young subjects, herniæ of moderat size, where the rings and canal are still present and not stretched an converted into one large direct gap into which the tips of two or thre fingers can be easily placed; cases where the patients operated on hav sense enough to give the newly repaired structures sufficient rest fo their consolidation, and where, if they must follow employment o exercise that involves much straining, they will give the parts th support of a truss of light pressure or a belt* (*vide infra*). If this i not done we shall see, if cases are carefully followed up and candidly reported, that radical cures will not last a lifetime, and that the term will have to be largely replaced by the following, according to the degree of cure obtained—viz., "complete successes," "partial successes," "complete failures."

Since Bassini published, in 1888, the description of his operation, this method, either as first described or modified in some slight degree, has become more and more popular, and, at the present time, its adoption may be said to be almost universal. Drs. Bull and Coley (*loc. supra cit.*) have given the results of the operations by Bassini's method which they have performed up to September 1898. In all there are 343 operations with only three relapses. It is true that some of these operations had been done quite recently, and the true result in these could not therefore be finally decided; nevertheless, since many of the operations had been done over five years before publication, the results, taken as a whole, must be considered very satisfactory, and more excellent than any large collection of cases yet published.

Drs. Bull and Coley also give an analysis of 360 cases of relapse after operations for radical cure, that were seen at the New York Hospital for Ruptured and Crippled. In no less than 80 per cent. of the cases relapse had taken place within twelve months of the operation; on the other hand, in five cases the period was between ten and twenty-two years after operation.

It may be said, therefore, that after one year the chances of relapse are not great, although no absolute time limit can be given after which cure may be said to be absolute.

From the above it is clear that, when consulted as to the performance of a radical cure by patients the subject of hernia, they can be assured as to the safety of the operation and the probable permanence of the cure in favourable cases (*vide supra*). Furthermore, it is certain that if a relapse should occur the majority of patients will be better off than before the operation. The protrusion that appears will be smaller than the original rupture, more readily kept within bounds like a bubonocele, and a truss will be worn with greater comfort. On the other hand, if suppuration occur, and a thin-walled feeble cicatrix, sure to yield increasingly as years go on, is the only result, the outcome of the operation may leave the patient worse off than he was before.

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* Many will say that if any truss or support is worn afterwards the cure is not *radical;* I admit this, but reply that until published series of cases have been watched for a much longer period, we shall, as relapses may occur five or eight years after operation, do wisely to advise the above class of patients to support the restored region with a well-fitting truss of light pressure, and so bring about a permanent cure instead of a liability to relapse.

A question that often arises relates to **the wearing of a truss** and **the possibility of the hernia being cured by this means alone.**

The answer deciding between the wearing of a truss and an operation for radical cure will depend greatly on the mind of the surgeon consulted. If he is one of those who believe that this operation is too indiscriminately resorted to, he will hold that no operation, save for special reasons (*vide* Indications for Operation), is to be advised where the hernia can be kept up by a truss, and that a light and well-fitting truss is not the bugbear it is too often made out to be by those who advocate operation as the rule. It would be well if surgeons would spend some of that pain and trouble in ensuring that the truss fits, before it is thrown aside, which they give to inventing or modifying operations for radical cure, and if patients would exert a little more trouble and pains in getting a proper and well-fitting truss at a duly qualified instrument-maker's, instead of the first cheap trash which they see in a chemist's shop. I have pointed out below, under the heading Indications for Operation, the cases where this question of wearing a truss does not arise.*

When this question, whether the wearing of a truss will effect a radical cure, arises in the case of infants and children, these cases may be divided into the following groups. In one—and this is the largest of the three—the careful wearing of a truss by a child will permanently cure the rupture. In a second group—a large one—the hernia, though not cured, will be perfectly controlled with very slight inconvenience to the patient. In the third—a very small one—there is no tendency to spontaneous cure even when a suitable truss has been diligently worn.

On this follows naturally the next question: (3) **What is the earliest age at which an operation should be performed?** Below I have stated my opinion that while it is occasionally justifiable to operate in the second year of life, where a persisting hernia is large, it is, as a rule, better to defer operation till the age of four or later. In this connection the following expressions of opinion by Mr. Langton (*Brit. Med. Journ.*, April 19, 1899, p. 472) may be quoted: "The cases requiring operation are comparatively rare, and operation should not be recommended in infancy." And again: "Experience proves that hernia occurs at an age ill suited for operation, and that if properly treated (by truss) it is usually cured long before any question of operation arises."

(4) **The Advisability or Need of wearing a Truss afterwards.**—The tendency of the present day to condemn offhand or to deprecate

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* An ill-fitting truss is, of course, worse than useless, and may mat together the tissues.

strongly the use of a truss after an operation for radical cure is, I think, a great mistake. Each case must be judged separately, With regard to children, from an experience of my cases, I think that if the recumbent position be insisted on for three months after the operation, so as to give the newly restored parts time to consolidate firmly, a truss will not be subsequently required, so great is the tendency to repair in early life. Umbilical herniæ I am inclined to make an exception. The communication which has here been closed has been relatively so large, the stress thrown upon it after repair in expiratory efforts (as when the child cries every time at the approach of the surgeon or dresser during the after-treatment) is so direct, that the scar should, I think, have support for some time in the form of a well-fitting belt.*

In adults the objection usually made to a truss is that its pressure will produce absorption of the scar. While it will be granted at once that any continuous pressure in the form of a pad with a strong spring will tend to weaken and remove the inflammatory thickening resulting from the operation, I am distinctly of opinion that some well-fitting slight support in the form of a truss or belt should be worn in the following cases—viz., where the abdominal walls are very fat, flabby and pendulous; where there is heavy work either done continuously or by fits and starts; where any silk has worked out, or where the wound has healed by suppuration (*vide supra*, p. 57); in some cases where the radical cure has been done after an operation for the relief of strangulation, and the surgeon has perhaps been hurried, or has operated at night; and, of course, in cases where there is any return of the hernia. Other cases are umbilical herniæ, both in adults and children, for the reason I have given above; in femoral herniæ, owing to the difficulty, in many cases, of doing more than twisting, tying, or inverting the sac (p. 79), and also because the sex and dress of the patient usually make the wearing of a truss less irksome. On the other hand, in early congenital cases, in boys, in young adults without laborious work, or where the reparative power is good, where sufficient rest has been taken after the operation, and where primary union has been secured and remains firm, no truss need be worn. But the importance of intelligent supervision at intervals should be insisted upon.

The presence of a cough, carelessness about constipation, or a stricture will, of course, be duly weighed; and I may remind my readers of a warning uttered at p. 55, that relapse may take place as late as four or even eight years after a skilfully performed operation.

On the other hand, it is only fair to say that the opinion on this matter expressed by others is widely divergent on some points from that given above. For instance, Drs. Bull and Coley (*loc. supra cit.*) say: "Personally we never advise a truss in children after operation, and we consider the recumbent position for three months entirely unnecessary. Our experience, based on a series of upwards of 600 cases of hernia in children under fourteen years of age, has shown that two, to two and a half weeks is ample time for the child to remain in bed. The subsequent history of these cases has been traced with scrupulous care, and some of them have been well upwards of seven years. Even in adults we very seldom advise a truss after operation. There are, however, some cases in which a permanent cure will be more likely to be obtained if a support be worn after operation. Such cases are those beyond middle age, with poorly developed and flabby abdominal muscles and a superabundance of fat. We would also include cases in which the hernia is of unusual size in adults past middle life."

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* Any phimosis or cough should, of course, be treated.

Lockwood (*Hernia, Hydrocele, and Varicocele*), again, does not order a truss after operation, except in cases in which some support is specially called for. He says: "So far as I can see, it is time enough to order a truss when signs of recurrence appear. After radical cure has been done, relapse seldom occurs suddenly. When the sac has been thoroughly obliterated by the operation, the hernial protrusion has to make for itself a new one; this is usually a slow process and accompanied by pain from the beginning." This practice is clearly justified by results, for Lockwood's list of cases shows only five relapses in ninety-one cases, in periods varying from six months to seven years. It may be noted, also, that in each of these five cases the relapse occurred within twelve months.

(5) **The Best Form of Suture.**—Though hitherto I have used silk, I am of opinion that kangaroo-tendon, if a suitable specimen, duly sterilised, can be obtained, will be found preferable, and I intend to make trial of this in future. Silk is most satisfactory to work with at the time; it can be obtained at once, it is soon sterilised, it is strong, and it lends itself readily to easy tying and a secure knot. But the after-result is, in my opinion, less satisfactory, owing to its liability to come away, often persistently. There is a tendency to believe and teach that wherever silk comes away after an operation, it must always be due to some deficient sterilisation of the silk, or to some failure to keep the wound aseptic. While these are leading causes, they are not, I am persuaded, the only ones; the site and the character of the tissues concerned play a very important part. Inside the peritonæal cavity, where the ligature lies deep and is surrounded by a serous membrane, as in an ovarian pedicle, we are certain our silk ligature will give no trouble; in ligature of the carotid or femoral artery, where the ligature also lies deep and is surrounded by vascular structures, we have rarely trouble with our silk ligatures; but here, where any silk used lies comparatively superficially and embedded in fibrous tissues such as the conjoined tendon or Poupart's ligament, its surroundings are so different that a surgeon need not always blame himself for deficient asepsis or faulty tying when his silk comes away. I am aware that many surgeons, higher authorities than myself, claim that silk, wire, salmon-gut can all be used as buried sutures without any further trouble. In a certain and large proportion I know from experience that silk can be used, but in a considerable number this and the other materials most certainly cause trouble later on. The wound runs an aseptic course, heals without suppuration, and then, after a varying period, a sinus appears, and one or more of the sutures have to be removed. Prof. Macewen uses chromicised catgut, prepared by himself. Drs. Bull and Coley, in the paper referred to above, used kangaroo-tendon in 342 cases, and though the interval between the date of operation and that of publication is in very many of them far too brief for the cure to deserve, in my opinion, the term "radical," the constancy with which primary union was secured speaks very strongly, I think, for the use of kangaroo-tendon in preference to silk.

Indications.—The following are given only as types of appropriate cases. Many others will suggest themselves:

i. Cases of irreducible hernia where other treatment has failed, where an active life is interfered with, or where attacks of inflammation have occurred, or strangulation is threatened. Subjects of inguinal hernia with adherent omentum are never really safe, especially if of active life: from this, however, they are usually debarred. Femoral herniæ containing irreducible omentum should also be operated on. These herniæ are difficult to fit with trusses; the omentum keeps the ring open, and thus paves the way for the descent of bowel on any sudden exertion. Where irreducible herniæ are small, and the adhesions easily separated, great relief will be given the patient with very slight risk. But it is otherwise where the sac is very large, or the contents adherent, especially about the neck of the sac. In either case the risk of the operation is increased, in the one case from the direct opening into the peritonæal cavity which may be present, the large amount of contents which have to be manipulated, and the difficulty of keeping the operation extra-peritonæal. Again, intricate adhesions about the neck of the sac may either lead the surgeon to abandon the operation, or to lay open the abdominal wall in order to deal with them. This last step not only increases the risk of peritonitis at the time, but may bring about, some time later, a hernia very difficult of control, the ultimate improvement in the patient's condition being thus of a very limited nature.

ii. Cases of strangulated hernia, where the patient's condition admits of the operation being prolonged.

iii. Cases where a hernia is not controlled by a truss, but slips beneath it. Such cases would be extremely rare if patient and surgeon alike showed sufficient pains and patience in securing a well-fitting truss.

iv. Cases of hernia with ectopia testis where the fitting of a truss to keep the hernia up and the testicle down fails. Castration should always be performed when the condition of the testis is useless or doubtful.

v. Cases where the hernia can be controlled by a truss, but the use of this is irksome to a patient of very active life, where he wishes to join the army or navy, or where he may, as a colonist, be far removed from surgical help.

vi. Children of poor, ignorant, and incompetent parents, with large herniæ, where proper attention to the use of a truss cannot be secured, or where the persevering use of this has failed, and where all such causes as phimosis, cough, &c., have been removed. It will probably be justifiable to go further than this, and to operate for radical cure in most cases of herniæ in the children of the poor in which the hernia is still large at four to six years of age.* By this time the parts are better developed and more easily kept aseptic. The sac is more easily dealt with now than later. The presence of any conditions which call for exploration—viz., hydrocele, adherent omentum, the presence of the appendix—will also be indications for operation in children. On this point, operation for radical cure in little children,† I will quote Mr. Macready

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* This age is mentioned above as giving time for sufficient trials with a truss.

† Before deciding that a well-made truss will not keep up a difficult case—*e.g.*, a double inguinal hernia—the hernia should be completely reduced with the aid of an anæsthetic.

(*loc. supra cit.*, p. 256). We may all envy his special experience and strive to imitate his skill. "Uncontrollable ruptures in children under fifteen are very rare; to me, indeed, they are as yet unknown. I hope it does not imply any lack of charity to say that one can measure with fair accuracy a surgeon's skill in the management of trusses by the number of curative operations he performs on children."

vii. Large herniæ, even colossal, where the patients, unfitted for work of any kind, are a burden to themselves and others,* and perhaps willing to run great risks; for it cannot be denied that these are very grave cases: "The operation usually difficult and prolonged, and the dangers to be met and overcome both numerous and various" (Banks). The chief of these is the direct and gaping communication with the peritonæal cavity and the difficulty in keeping the operation extra-peritonæal. The best proof of this is given by Sir W. M. Banks' series of sixteen very large and enormous herniæ; of these he lost four, two from septicæmia. In another, even his hands failed to complete the operation.

viii. I consider ten to twenty-five years of age the most favourable time, as combining parts easy to handle, the possibility of keeping the wound aseptic, probable absence of any difficult adhesions, and good vitality and health.

Choice of Operation.—The following have been brought prominently before the profession, viz.:

i. **Operation by Open Method.**
ii. **Subcutaneous Methods**—*e.g.*, **Prof. Wood's and Mr. Spanton's.**
iii. **Injection of Astringents**—*e.g.*, **Oak-bark.**

Of these, only the operation by open method will be described, as it is the one of all others which is generally chosen, owing to the excellent results which it has given, the precision with which the structures concerned can be avoided or manipulated, and its safety when aseptic precautions are strictly observed.

i. **The Operation by Open Method.**†—The patient having been kept in bed for some time before, according to the size of the hernia, and any cough attended to, only liquid diet is given for the few days preceding the operation, and the bowels are duly emptied.

Before describing the different methods mostly in vogue, I will allude, for the sake of my younger readers, to a few points which are always of importance, whichever method is selected.

The thigh being a little flexed, an incision is made over the inguinal canal, and extending an inch below the external abdominal ring. This divides skin and fasciæ and several branches of the external pudic arteries; these should be secured with Spencer Wells's forceps, which will also open out the wound. In young males, especially, where these vessels are of considerable size, care must be taken that each point is firmly closed either by the forci-pressure or catgut ligature; otherwise free bleeding may readily take place in the lax tissues of the groin, pre-

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[*] As in three cases given by Sir W. M. Banks: one, a labourer, unfitted for work, had become an inmate of a workhouse; the second was a wine merchant, who had been obliged to give up his business, rarely venturing out, and then obliged to conceal his deformity under a large overcoat; the third, a glass-blower, reduced to perfect helplessness, had to depend on his wife for his support.

[†] The following remarks apply to inguinal hernia.

venting primary union, and perhaps leading to most troublesome tension and suppuration. The aponeurosis of the external oblique and the cremasteric fascia having been next divided, the site of the cord is made certain of, and the sac most carefully defined. This, if empty, is by no means always easy, especially in young subjects. In defining the sac, care should be taken to work carefully and without any needless disturbance of the parts, or separation of the planes of tissue here met with. So, too, with the cord—great care must be taken in the next step, when the sac and this structure are separated; hasty work may lead to needless hæmorrhage from ruptured veins, injury to the sac, or subsequent epididymo-orchitis, and even sloughing of the epididymis with part of the testicle. The sac having been accurately defined, is opened so that an aseptic finger may make sure that it is empty; otherwise any intestine is completely reduced or omentum dealt with according to the steps given at p. 37. If the question arise, whether the sac should always be opened, I should answer "Yes." Even if it appear empty below, it is satisfactory to be assured by digital examination that nothing lies within the neck before this is twisted or tied as high up as possible. A case of Busch's (*Klin. Med. Woch.*, 1882, No. 31, p. 473) shows the importance of taking this step.

Operating on a boy 2¾ years old for a right inguinal hernia, Busch tied the sac before opening it. When it was cut into below the ligature the vermiform appendix was found included. This was released and returned. Some time later Busch was operating on the left side, and again found that he had included the appendix in his ligature round the sac.

When the emptied sac is next separated from the cord and adjacent parts,* care must be taken, if the patient strain at this time, that no escape of intestine occur, an assistant maintaining pressure over the internal ring. The cord must be treated with the precautions given above, and care must be taken that the testicle is not dragged needlessly out of its bed. The sac is now treated, and the canal closed by one of the methods given in detail below. The wound having been thoroughly dried out, and some sterilised iodoform dusted into its recesses, it is closed with sutures of salmon-gut or horsehair, care being taken that no inversion of the edges is present, and, of far more importance, that all hæmorrhage has been entirely stopped, including those points from which Spencer Wells's forceps have been removed. If absolute dryness of the wound has been secured, and the operation has been aseptic throughout, no drainage is needed. A slip of green protective out of carbolic acid lotion (1 in 20), and some strips of iodoform gauze wrung out of the same, are then placed next the wound, and covered by any of the antiseptic gauzes or wools. It is important to keep the scrotum well up on the pubes, and thus minimise the risks of œdema of the scrotum and epididymo-orchitis.

To the above general remarks I have only to add that it is always well, when the radical cure is performed in patients with long-standing hernia (with important parts and the sac perhaps very adherent), or a voluminous one, for the operator to obtain leave beforehand to sacrifice the testicle; and the same course will be taken when a retained testicle is found to be probably functionless. If it is worth while to fix this again in the scrotum, this should be done according to the steps given under the heading of Orchidopexy.

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* If much difficulty is met with here, the surgeon should begin high up, as near the internal ring as possible, dividing the external oblique aponeurosis.

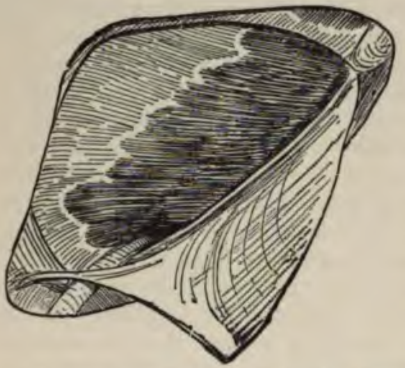
Any child or restless patient should be secured in a long outside splint. Finally, if any stitch-sinus appear, that part of the wound should be well scraped out at once, and made to heal from the bottom.

The different methods that have been elaborated are very numerous, and only those which are chiefly in vogue at the present time can be described here in full. Brief mention will, however, be made of some of the others. It will be seen, if these various methods be compared with one another, that, whereas most of them are alike in aiming at reconstituting, in some degree, the original valvular condition of the inguinal canal, on the other hand, they differ chiefly as regards the method of dealing with the hernial sac.

Taking the latter point first, it will be seen that the various special methods that have been devised for dealing with the sac aim chiefly at converting the normal depression, or peritonæal fossa, at the position of the internal abdominal ring, into a prominence with its convexity towards the abdominal cavity. Even if the operation does succeed in attaining this, it must surely be only temporary, for, clearly, the sac will rapidly shrink and undergo partial absorption. Moreover, since there is normally a slight depression in this position, and since only a very small proportion of all individuals suffer from inguinal hernia, it is clear that the removal of the depression at the site of the internal abdominal ring is not to be looked upon as the most important part of an operation for the radical cure of a hernia. This contention is borne out by the results of operation, for in Bassini's operation, which is so successful as to be almost considered perfect (*vide* p. 56 for results), the sac is simply ligatured at its neck, and the rest removed, leaving, therefore, a depression in the peritonæum opposite the ligature. With regard to the question of the inguinal canal, it is clear that the normal valvular arrangement (*vide* Fig. 12) of the canal is extremely satisfactory in preventing the descent of an inguinal hernia, since such a very small proportion of all individuals suffer from this condition. This would lead one to expect that that operation which most satisfactorily and simply reconstitutes the original condition of the inguinal canal will be attended with the most satisfactory results. Bassini's operation practically does reconstitute the normal inguinal canal, and moreover justifies the above argument, since the results are so satisfactory and its adoption is so widespread. Other advantages of Bassini's method are, that it is easy and straightforward to perform, and that the whole length of the canal is exposed to view, thus allowing (as pointed out by Lockwood) the removal of any conditions which may be liable to distend the inguinal canal, such as lipomata of the cord or inguinal varicoceles. For these reasons Bassini's operation will be described first.

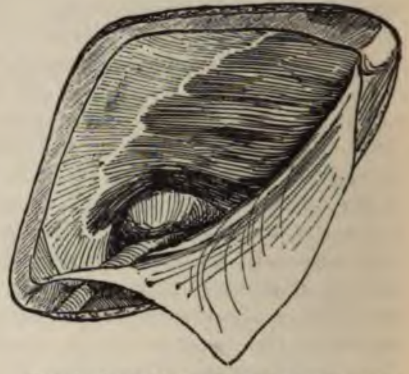
(1.) *Bassini's Method* (Fig. 14).—An oblique incision, at least four inches long in an adult, somewhat less in a child, is made over the position of the inguinal canal, and ending below opposite the pubic crest. The fascia having been divided, the external oblique aponeurosis is exposed and the external abdominal ring identified. The external oblique is now divided along the length of the canal, and flaps separated in both directions for a short distance, thus thoroughly exposing the whole length of the inguinal canal. The sac is now identified and carefully separated from the cord well up to the level of the internal ring. It is then opened and carefully emptied, all adhesions being carefully separated, and omentum either ligatured and removed or reduced. The neck of the sac having been somewhat pulled down, is transfixed and ligatured with silk or kangaroo-tendon at the highest possible point, then divided about half an inch below the ligature, and the rest of the sac removed. Next, the cord is raised carefully from its bed, and, supported in a loop of gauze, is held forward by an assistant while the sutures are introduced. At this stage any lipomata of the cord or an inguinal varicocele may be removed, as advised by Lockwood. The posterior wall of the inguinal canal is now repaired by means of sutures. These will vary in number from two to five, according to the size of the gap between the internal oblique or conjoined tendon on the one hand, and Poupart's ligament on the other (*vide* Fig. 13). These sutures consist either of kangaroo-tendon or silk, and are passed in the following manner:—The needle is first passed through the deep aspect of Poupart's ligament, then beneath the uplifted cord, and finally through the lower margin of the internal oblique or conjoined tendon. In order to avoid wounding the peritonæum, the needle is passed through the conjoined tendon from its deep to its superficial aspect (*vide* Fig. 14). Sufficient sutures having been passed, they are tied carefully and cut short, and the cord allowed to fall back into its place. The divided edges of the external oblique are now united by means of a fine continuous suture, and the external ring, if large, partially closed at the same time. All bleeding having been carefully arrested, the skin is sutured and the dressings applied.

FIG. 12.



A normal inguinal canal. Arciform fibres compressing the cord against Poupart's ligament. (Lockwood.)

FIG. 13.



Inguinal canal in case of hernia. The arciform fibres are displaced upwards, the normal valvular condition of the canal being thereby destroyed. (Lockwood.)

(2.) *Macewen's Operation** (Figs. 15 to 21).

The object of this is twofold: (1) So thoroughly to separate the sac as to allow of its being completely reduced into the abdominal cavity, there to rest on the inner surface of the ring, and acting as a bulwark-like pad to "shed the intestinal waves away" from it. Prof. Macewen thinks that if the sac be merely tied, however carefully and high up this is done, there remains a funnel shaped puckering, the apex of which presents in the internal ring, and that this pouch gradually becomes a wedge, tending to open up the canal.

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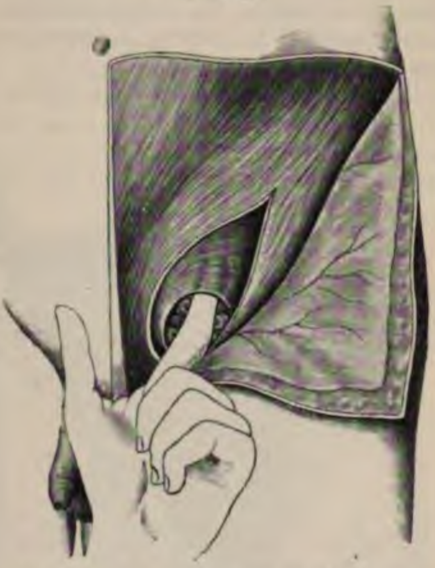
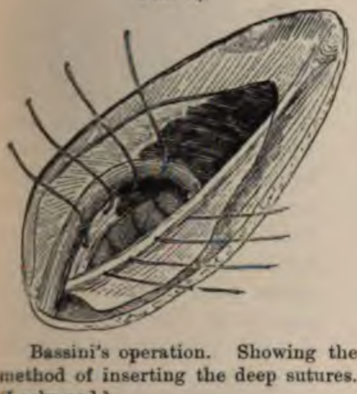
* *Ann. of Surg.*, Aug. 1886; *Brit. Med. Journ.*, Dec. 10, 1887.

FIG. 15.



Macewen's operation. The index finger, inserted along the inguinal canal, is separating the peritonæum from the internal aspect of the internal ring. The folded sac is behind. In this and the following figures a flap of skin and cellular tissue has been reflected, and the external oblique opened up so as to expose the canal and internal ring.

FIG. 14.



Bassini's operation. Showing the method of inserting the deep sutures. (Lockwood.)

Thorough separation of the sac, and carrying this well within the peritonæal cavity, is absolutely needful, for if the sac be left in the canal it will act as a plug, keeping it open. (2) Again, to close the dilated canal and restore its natural valve-like condition by a particular mode of inserting sutures which bring the conjoined tendon in close apposition with Poupart's ligament, beginning with that part of the ligament which is on a level with the lowest part of the internal ring.

The first object is thus ensured:—The external ring having been exposed, the internal ring and site of the deep epigastric are examined, and the sac next freed and raised. When this has been done it is kept pulled down while the index-finger separates the sac from the cord, the canal, and finally for half an inch around the abdominal aspect of the internal ring[*] (Fig. 15). The sac is now folded on itself (Figs. 16, 17) by means of a stitch which is firmly fixed in the distal end of the sac. The free end, threaded on a hernia-needle (Fig. 17), is introduced through the canal to the abdominal aspect of the fascia transversalis, and there penetrates the abdominal wall about an inch above the internal ring (Fig. 16). The wound in the skin is pulled upwards,* so as to allow the point of the needle to project through the muscles without penetrating the skin. The needle being withdrawn and unthreaded, by traction on the thread the folded sac is drawn still further backwards and upwards. Traction having been kept up on the thread while the sutures closing the canal are introduced, it is finally secured by passing it several times through the external oblique muscle.

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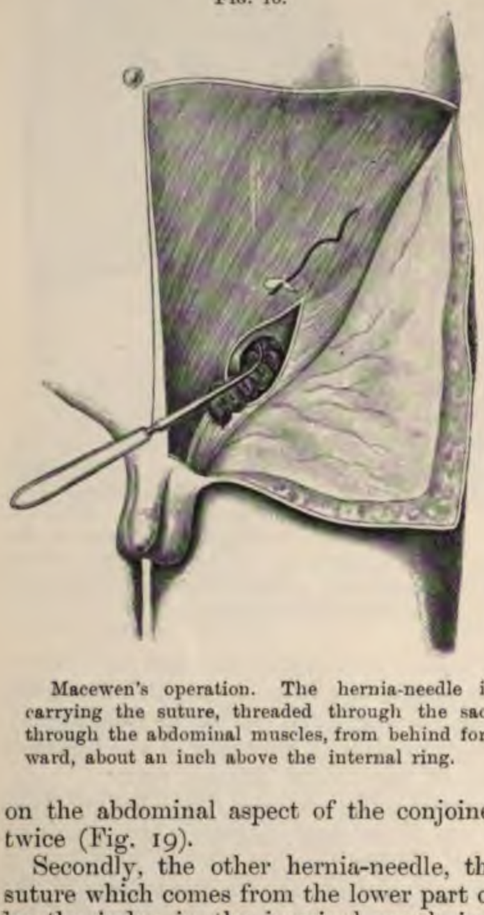
[*] The object of this is to refresh the abdominal aspect of the internal ring so that adhesions may form between it and the pad of sac.

The second part of the operation, closure of the inguinal canal, is now undertaken. The finger, passed into the canal and lying between the inner and lower border of the internal ring in front of and above the cord, makes out the position of the deep epigastric artery so as to avoid it.

FIG. 16.



Macewen's operation. The hernia-needle is carrying the suture, threaded through the sac, through the abdominal muscles, from behind forward, about an inch above the internal ring.

The hernia-needle, carrying chromic gut, then, guided by the index, is made to penetrate the conjoined tendon in two places: first, from without inwards near the lower border of the conjoined tendon; and secondly, from within outwards, as high up as possible in the inner aspect of the canal: this double penetration of the conjoined tendon being accomplished by a single screw-like turn of the instrument (Fig. 18). One end of the suture is then withdrawn, and the needle, with the other end, is removed. Thus, a loop is left on the abdominal aspect of the conjoined tendon, which is penetrated twice (Fig. 19).

Secondly, the other hernia-needle, threaded with that part of the suture which comes from the lower part of the conjoined tendon, guided by the index in the inguinal canal, is passed from within outwards through Poupart's ligament, which it penetrates at a point on a level with the lower suture in the conjoined tendon (Fig. 20). The needle is then completely freed from the suture and withdrawn.

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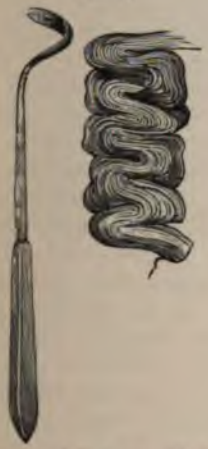
* Beginners will find it best to divide the aponeurosis of the external oblique, and so obtain sufficient room for rightly dealing with the sac. This requires an additional row of sutures, and may weaken the abdominal wall. On the other hand, beginners will always find it difficult, however much the upper angle of the wound is pulled up, to get the sac detached really high up, and to put the needful sutures into the conjoined tendon with the limited incision which is sufficient for the experienced hands of Prof. Macewen.

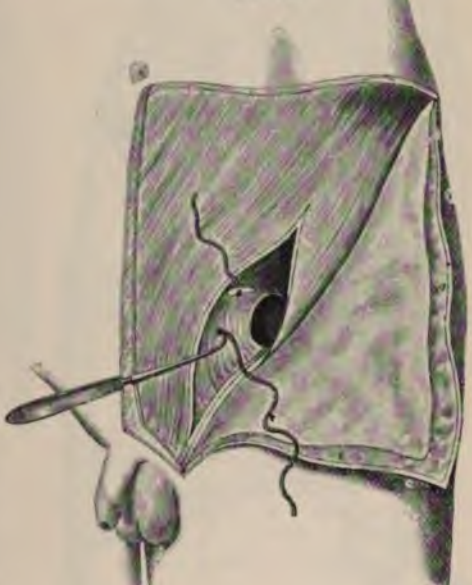
Thirdly, the needle, now threaded with that part of the catgut which protrudes from the upper border of the conjoined tendon, is passed from within outwards through the transversalis and internal oblique muscles and the aponeurosis of the external oblique at a point on a level with the upper stitch in the conjoined tendon. It is then quite freed from the suture and withdrawn. There are now two free ends in the outer surface on the external oblique, continuous with the loop on the abdominal surface of the conjoined tendon (Fig. 21). The two free ends being drawn together tightly, and tied as a reef-knot, the internal ring is firmly closed. The same stitch may be repeated lower down in the canal, especially in adults, with wide gaps. The pillars of the external ring may likewise be brought together. In the great majority of cases the first or uppermost stitch is all that is required. The cord should lie behind and below the sutures and be freely movable in the canal. It is advisable to introduce all the sutures before tightening any of them. They may then be experimentally drawn tight while a finger is introduced into the canal to learn the result. During the operation the skin is drawn from side to side to bring the parts into

FIG. 17.



On the left is one of Prof. Macewen's needles.* They are made of one piece of steel. To the right is the sac, transfixed and thrown into a series of folds by a thread which should be shown emerging above as well as below.

FIG. 18.



Macewen's operation. A hernia-needle (loaded) has been made to penetrate the conjoined tendon in two places.

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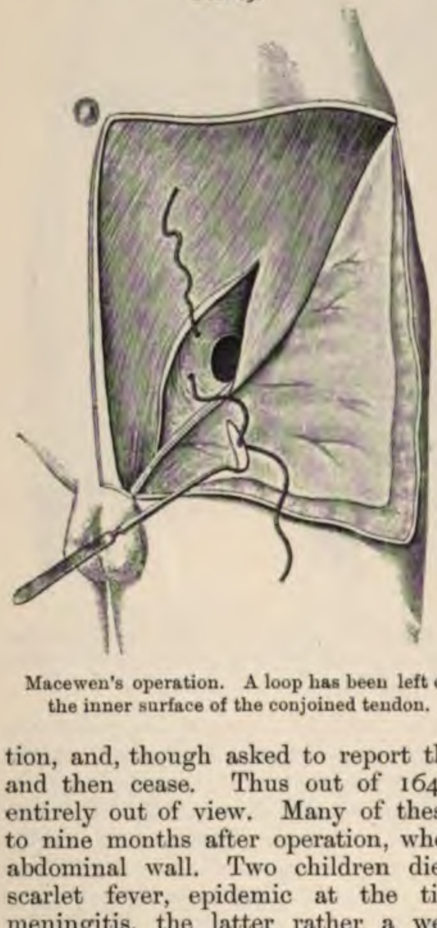
* These are two in number, one for passing the thread from right to left, and the other from left to right. I have found Mr. Watson Cheyne's modification of the above needles, in which the instrument is angular instead of curved, much more convenient for picking up the conjoined tendon and external oblique.

view. The skin falling into position, the wound is opposite to the external ring, the operation being partly subcutaneous.

In congenital hernia the sac is first separated from its connection with the canal. It is then opened, and divided transversely into two parts, care being taken to preserve the cord. The lower part forms a tunica vaginalis. The upper is pulled down as far as possible, split behind longitudinally, so as to allow the cord to escape, and its lower end closed by a stitch or two. It is then dealt with quite as the sac of an acquired hernia.

The following points deserve attention.

FIG. 19.



Macewen's operation. A loop has been left on the inner surface of the conjoined tendon.

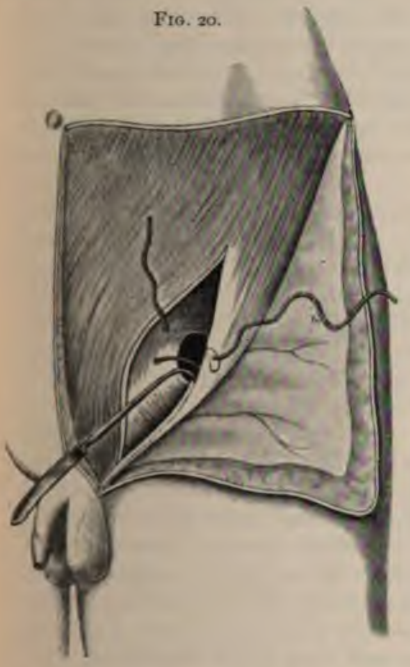
The method has been objected to as complicated and difficult, and as inapplicable to infants on account of the difficulty of making out any conjoined tendon at this age. The above objections will disappear with practice. As Prof. Macewen has stated, a skilled finger will detect the conjoined tendon even in early life. Smaller needles must, of course, now be used. Other difficulties are met with in this method when the sac is unusually coarse and thick, or when it is extremely thin; such sacs are, no doubt, difficult to manipulate satisfactorily, so as to get the pad well within the internal ring.

Professor Macewen kindly forwarded to me the following statement (July 1895) as to his results:

"I have had 164 completed cases of operation for oblique inguinal hernia. Regarding radical cures, one must necessarily be guarded in drawing conclusions when dealing with large numbers, as many of the patients pass from observation, and, though asked to report themselves, do so only a few times, and then cease. Thus out of 164 there are 55 who have dropped entirely out of view. Many of these had previously been seen three to nine months after operation, when they had firm occlusion of the abdominal wall. Two children died after the operation—one from scarlet fever, epidemic at the time, and one from measles and meningitis, the latter rather a weak child. This leaves 107; of these, five are known to have had return. Two of these were steel workers, doing the heaviest kind of work. One was cured during eight years, and then a slight bulge appeared near the seat of the former hernia. He now has a bubonocele. The other was two years free from hernia, and then had a slight rupture. Each of those wear belts—

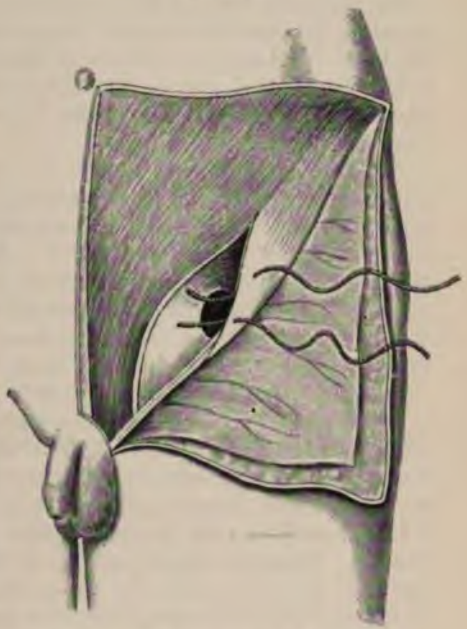
light ones, which retain the hernia even during their work. A third remained well for two years, then had an attack of what was stated to be enteric fever, and subsequently became affected with tubercle of the lungs. He had a distinct recurrence of the hernia. A fourth I have heard of as having a return to a slight extent, and a fifth wrote to say that he had a return.

FIG. 20.



Macewen's operation. The thread from the lower part of the conjoined tendon has been carried through Poupart's ligament.

FIG. 21.



Macewen's operation. Two of the threads which are to draw the conjoined tendon over to Poupart's ligament are in position ready for tying.

"If we strike off nine cures under two years, which are well, but which are too recent to be judged as cures, this leaves—

20	reported or seen	cured—no	truss—at	10	years	and over.
11	,,	,,	,,	,, 8	,,	,,
18	,,	,,	,,	,, 6	,,	,,
29	,,	,,	,,	,, 4	,,	,,
15	,,	,,	,,	,, 2	,,	,,
93						

Some of the older ones have been good enough to keep me well informed as to their state. Two have gone through a great deal of hard riding in Cape, for many months at a time, and have never been bothered with their old enemy. One, a surgeon in the Cumberland district, rides a great deal and never is troubled. He says he has forgotten that he ever had a hernia."

Although in Prof. Macewen's hands this method has been attended with good results, when performed by other surgeons the results have not been so satisfactory. It is clearly a more difficult and complicated procedure than Bassini's, and moreover the results of Bassini's method are better (*vide supra*, p. 56). Probably it is for these reasons that Bassini's method is preferred by the majority of operators.

(3.) *Ball's Method* (*Brit. Med. Journ.*, Dec. 10, 1887).—Here the sac is twisted, the fundus cut away, and the stump stitched in the ring. I have placed this method next because I consider the method of treating the sac by torsion much simpler than any other, and very efficient. I always treat the sac thus myself, though instead of leaving it in the canal I return it within the internal abdominal ring after Macewen's method, and I also make use of Macewen's method for closing the canal.

Mr. Ball advises that the sac be completely isolated right up to the internal ring, and having been ascertained to be empty, gradually twisted up by a broad catch-forceps grasping its neck, while the left forefinger frees the upper part of the neck.* In ordinary cases, four to five complete revolutions are sufficient, but this must depend on the thickness of the sac, the torsion being continued till it is felt to be quite tight and likely to rupture. An assistant now, holding the torsion-forceps, maintains the twist while a stout catgut ligature is tied tightly round the twisted neck and cut short. Two sutures of stout aseptic silk are now passed through the skin about half an inch from the edge of the wound, through the outer pillar of the ring, through the twisted sac in front of the catgut suture, and then through the inner pillar and skin. As the sac now cannot untwist, it is cut off in front of these sutures, which are tied over leaden plates that lie at right angles to the wound. From investigations on the dead body, Mr. Ball finds that the result of the above procedure is to throw the peritonæum into a number of special folds, radiating from the internal ring in all directions. The ring, instead of being depressed, is rendered more prominent than the neighbouring peritonæum.

I have used this most simple and efficient method very largely, but with some modifications of the author's plan. Thus, before twisting the sac and after freeing it below and from the cord, I endeavour to separate it all around the abdominal aspect of the internal ring. After twisting it up as high and as tightly as possible, I always, if it be thick enough, transfix it instead of merely encircling it with a gut ligature. It is then pushed well within the peritonæal cavity, as I should fear leaving it in the canal lest it act as a wedge and dilate it. Finally, I always supplement torsion of the sac by closing the canal with sutures introduced by Macewen's method.

Torsion is very quickly and simply done; moreover, it does away with the need of bringing a thread through the abdominal wall. Another advantage is the crushing together of serous surfaces, which tends by plastic effusion to make a plug very efficient in blocking the internal ring, aided by the slight effusion which is set up by the separation of the sac around the abdominal aspect of this aperture.

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* Where the hernia is congenital, the sac must be cut through first above the testicle, freed from the cord, and then twisted.

(4.) *Method of Banks.*[*]—This has the merit of extreme simplicity. The sac having been made certain of, is separated, with the precautions given above (p. 62), from the cord, and detached through the external ring up in the canal as high as the internal ring, the finger keeping note all the time of the position of the cord. If the sac is clearly empty, its neck is now ligatured with stout chromic gut or carbolised silk as high up as to leave no neck, orifice, or dimple at the internal ring. The fundus is then cut away about half an inch below the ligature. As to sutures of the ring and canals, it would appear from his latest paper that the author is now satisfied with suturing the external ring. "In inguinal herniæ, in addition to this" (dissecting out and removing the sac as high up as possible), "the pillars of the external ring have been pulled together by two or three silver wire sutures, which are left in position after their ends have been cut very short. They thus constitute three small silver rings, which never appear again, and are less irritating than any other form of suture. I do not put them in with any object of securing a permanent closure of the external ring, but simply to make sure that the hernia shall not descend for a considerable period, so that the inguinal canal (if it be in fairly normal case) may have a chance of contracting. Unless some extensive 'rawing' of the walls of the canal is done, I believe all stitching of it to be of just as much use in securing permanent union as stitching the edges of a cleft palate would be without freely refreshing them. I do not believe it possible satisfactorily to accomplish a 'rawing' of the inguinal canal, while in a very large proportion of severe cases there is no inguinal canal at all; nothing but a big hole into which three or four fingers can be crammed, whose edges are as thin as cardboard, and from which all anatomical relations have disappeared. My reason for adhering to the operation which I have hitherto used is that it is the simplest of any that has yet been devised."

While all will agree as to the simplicity of the above method, there is an increasing belief that ligature of the sac alone is not to be trusted—partly because a sac thus treated is not strong enough to resist future strains; partly because, as pointed out above by Prof. Macewen, it is extremely difficult, if not impossible, to tie the sac so high up that no dimple is left on the peritonæal aspect of the internal ring.

To take another very important point. Sir W. Banks seems to have given up attempting to draw the canal together with sutures, because these will not ensure *adhesion* of the walls. But surely there is a fallacy in his comparison. What we want here is not the adhesion of the two walls of the canal as in the halves of the soft palate, but a permanent narrowing of the canal again so that it may be once more a mere chink or valve instead of a short wide tunnel, or, as in severer cases, a gaping ring. Even if it were possible, *adhesion* of the walls of the canal would be undesirable for the sake of the cord.

With regard to suturing the external ring alone, this is, I fear, from cases I have seen, quite inadequate. Some attempt should always be made to narrow the internal ring and canal, as by the method of

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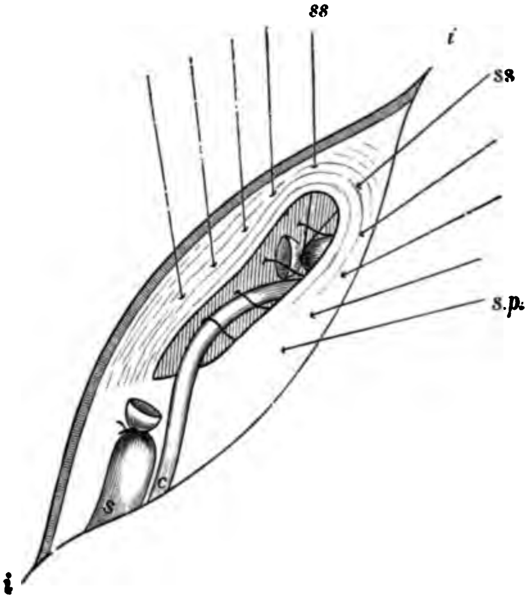
[*] Papers by the above surgeon, one of our earliest and foremost workers at the subject will be found in the *Med. Times and Gaz.*, 1884; *Brit. Med. Journ.*, Dec. 10, 1887, and Nov. 11, 1893.

Bassini. Finally, most surgeons have been less fortunate than Sir W Banks in their experience of silver wire. It is very readily sterilised most easily used, but often fails to become encysted.

(5.) *Barker's Method** (Fig. 22).—Here the upper part of the sac is drawn up into the abdomen and fixed there, but the lower part is always left *in situ*, as Mr. Barker thinks its removal unnecessary and even mischievous, "as during the dissection the nervous and vascular supply may be seriously damaged." The rings are then sutured.

The neck and upper part of the sac having been separated from adjacent parts, and proved to be empty, two ligatures of strong, fine carbolised silk are carried under the neck and tied about half an inch apart, and the sac divided between them. The upper ligatures are left long. The left forefinger, introduced into the canal and through the internal ring, is made to press its anterior wall forwards. One of the silk threads left long on the upper stump of the sac is now threaded on a needle with a handle, and carried up the canal, inside the internal ring, and through the abdominal wall above and external to the external ring. The other is similarly passed through the abdominal wall about half an inch to the inner side of the first. These sutures are then knotted tightly, and by this means the stump of the sac is drawn up into the abdomen and fixed there. The external ring is then closed

FIG. 22.



Barker's method. *i*, *i*, Skin incision. *c*, Spermatic cord. *s*, Lower part of sac left *in situ*. *ss*, Sutures to invaginate the upper part of the sac. *s.p*, Sutures for drawing the walls of the canal together.

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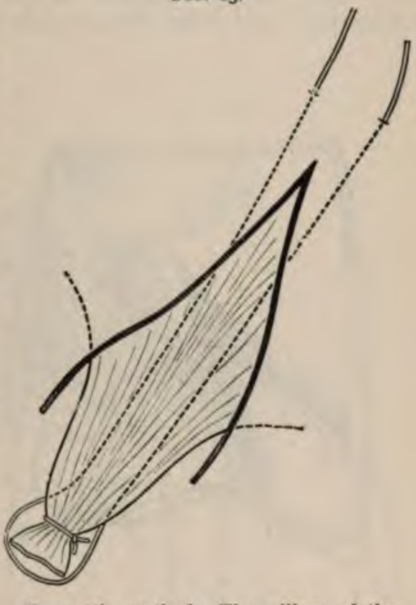
* *Brit. Med. Journ.*, Dec. 1887; *Man. of Oper. Surg.*, p. 334. Fig. 51; *Trans. Med.-Chir. Soc.*, vol. lxxiii. p. 273.

by sutures which should, if possible, take up the conjoined tendon as well.

(6.) *Bennett's Method** (Fig. 23).—Here also the lower part of the sac is left *in situ*, for reasons similar to those given above; the upper part of the sac is invaginated through the internal ring, and the canal sutured in the usual way.

The sac is exposed and carefully isolated from its connections just below the external ring (the lower part being left entirely undisturbed); it is then opened, and the contents reduced into the abdomen, if they have not already returned spontaneously.

FIG. 23.



Bennett's method. The pillars of the external ring are shown. Some distance above them the two invagination sutures are seen to emerge through the aponeuroses, while below they pass through the sac, which has also been tied.

The sac is now divided just below the external ring, the distal portion being allowed, after all bleeding has been stopped, to drop back into the scrotum. The proximal part of the sac is next separated from the sides of the canal as high up as the internal ring by gentle manipulation. One finger (or more if the ring is large) of the left hand having been introduced into the abdominal cavity through the neck of the sac, any bowel lying near the internal ring is pressed back out of the way. An ordinary pile-needle on a handle (unthreaded) is then made to enter the abdominal aponeuroses about three-quarters of an inch above the upper margin of the external ring, a little to the outer side of its middle line, and transfixes the whole of the aponeuroses and peritonæum, impinging on the end of the finger which occupies the neck of the sac. The needle, guided by the finger, is passed down the inside of the sac and made to pierce its outer wall at a point about half an inch from the cut edge. The needle having been threaded with a tendon or catgut suture, previously prepared, and not less than twelve inches long, is withdrawn, taking one end of the suture with it. The result is that one end of the suture is seen passing into the abdominal aponeuroses above the external ring, while the other issues from the outer wall of the proximal part of the sac, near its cut edge. The needle, again unthreaded, is now made to transfix the abdominal aponeuroses and peritonæum about half an inch internal to the point at which it entered before, traversing the sac in the same way, finally piercing the inner wall at about the same distance from the cut edge as it had done on the outer side. After having been threaded with the lower end of the suture, the needle is withdrawn, carrying the suture, as before, with it The two ends of the suture will now be seen entering the aponeuroses above the external ring, and forming below a loop over the cut edge of the proximal portion of the sac. The open end of the sac is next sewn up by a continuous stitch of catgut or silk, or occluded by a silk ligature placed around it as close as possible to the spot at which the invagination suture pierces its sides. The succeeding step is the invagination of the sac, which is effected by pushing with the finger the closed end through the canal into the abdomen, the invagination sutures passing through the aponeuroses being at the same time drawn tight. By this proceeding the sac is turned completely outside-in, and its fundus firmly attached to the peritonæal surface of the anterior abdominal wall some distance above the internal ring.

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* *Abdominal Hernia*, p. 188.

FIG. 24.

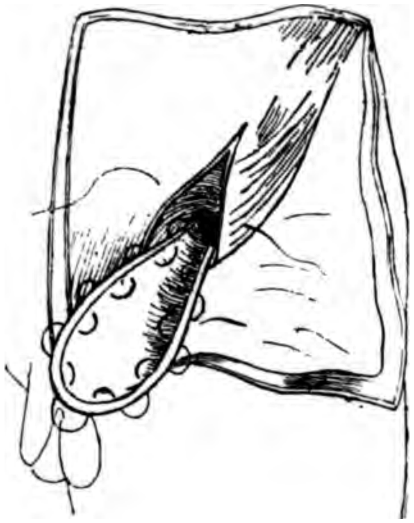


FIG. 25.

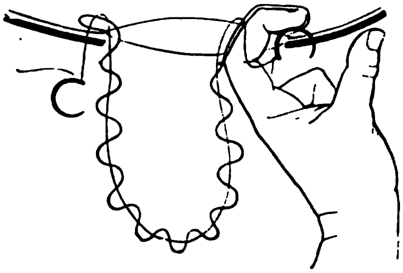
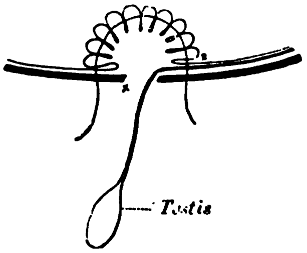


FIG. 26.



Figs. 24, 25, and 26: Method of treating the sac in Bishop's method of radical cure of hernia. In Fig. 24 the sac is hemmed round with a silk suture. In Fig. 25 the sac is puckered upon the outer side of the ring. In Fig. 26 the puckered sac is invaginated and forms a button-like projection on the abdominal aspect of the ring. In each figure the suture carries a needle at each end. (Walsham.)

(7.) *Stanmore Bishop's Method** (Figs. 24, 25, and 26).—This is a modification of Prof. Macewen's. The sac having been freed entirely up to but not beyond the internal ring, is carefully emptied, and kept so by the finger of an assistant pressing upon the ring. By means of a long, strong catgut suture, which is passed through each side of the sac, this is hemmed round, and thrown into a number of folds. The neck of the sac is then invaginated, and each end of the suture carried by a needle through the canal and through the pillar of the internal ring nearest to it, from within outwards. When both ends are presenting through the muscular structures they are pulled up, the sac being at the same time invaginated before the finger as the threads are drawn upon. The sac is then drawn inside-out in its passage, and becomes fixed at a rounded boss exactly over the inner ring, its peritonæal surface being turned towards the intestines, and its first fold on either side being firmly applied to the peritonæum immediately within the ring. The ends of the suture are then tied firmly, but not tightly, over the ring; finally, this and the canal are sutured.

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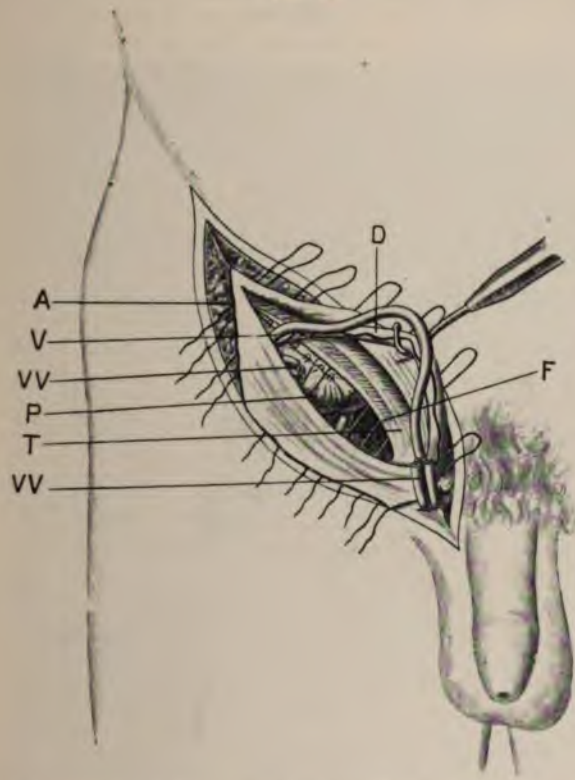
* *Lancet*, vol. i. 1890, p. 1237.

FIG. 27.



Halsted's operation. The inguinal canal laid open; the sac cut away after suture of the peritonæum; elements of cord isolated and lifted up; deep quilt sutures introduced.

A, Aponeurosis of the external oblique. D, Vas deferens. F, Fascia transversalis. P, Remains of sac sutured. T, Conjoined tendon. V, One of the spermatic veins. VV, Stumps of excised spermatic veins.

(8.) *Method of Halsted.*[*]—The following is Prof. Halsted's account of his operation (Figs. 27 and 28): "Instead of trying to repair the old canal and the internal abdominal ring, I make a new canal and a ring. The new ring should fit the cord as snugly as possible, and cord should be as small as possible. The skin incision extends fro point about 5 cm. above and external to the internal ring to the sp of the pubes. The subcutaneous tissues are divided, so as to exp clearly the aponeurosis of the external oblique and the external ri The aponeurosis of the external oblique, the internal oblique and tra versalis and the transversalis fascia are cut through from the exte

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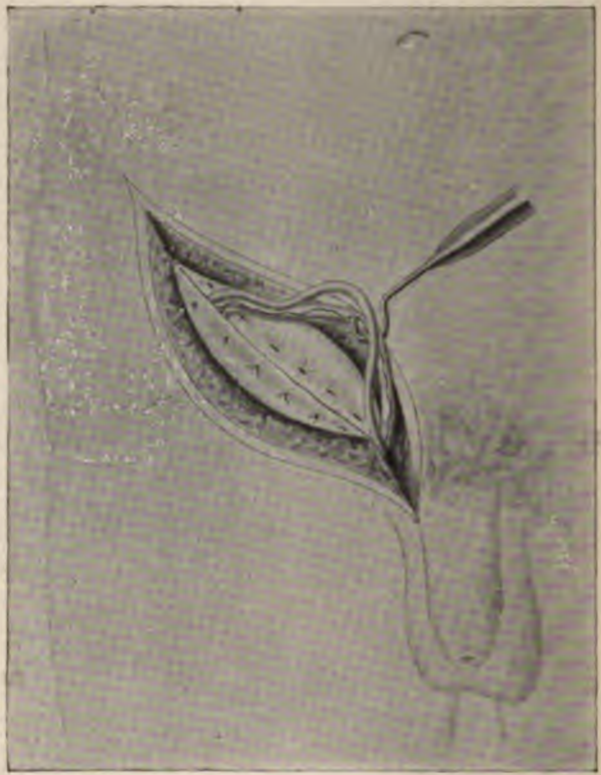
[*] Halsted. *Bulletin of the Johns Hopkins Hosp.*, vol. i. No. 1; *Johns Hopkins Hosp. Rep.*, vol. ii.; *Surg. Fasciculus*, No. 1; *Ann. of Surg.*, 1893, vol. i. p. 542.

Fig. 28.



Halsted's operation. The deep quilt sutures which cross the canal are tied an cut short. The remains of the cord are seen to emerge between the upper tw sutures, and to lie between the external oblique and the skin.

abdominal ring to a point about 2 cm. above and external to internal ring. The vas deferens and the blood-vessels of the cord isolated. *All but one or two of the veins of the cord are excised* (Fig. The sac is carefully isolated and opened, and its contents replaced. piece of gauze is usually employed to replace and retain the intesti With the division of the muscles and transversalis fascia, the so-ca neck of the sac vanishes. There is no longer a constriction of the The communication between the sac and the abdominal cavity sometimes large enough to admit one's hand. The sac having been completely isolated and its contents replaced, the peritonæal cavity is closed by a few fine silk mattress sutures, sometimes by a continuous suture. The sac is cut away close to the sutures. The cord in its reduced form is raised on a hook out of the wound, to facilitate the introduction of the six or eight quilt sutures, which pass through the aponeurosis of the external oblique, and through the internal oblique and transversalis muscles and transversalis fascia on the one hand, and through the transversalis fascia and Poupart's ligament and fibres of the aponeurosis of the external oblique on the other (Fig. 27). The two outermost of the deep quilt sutures pass through muscular tissues, and the same tissues on both sides of the wound. They are the most important sutures, for the transplanted cord passes out between them. If placed too close together, the circulation of the cord might be imperilled, and if too far apart the hernia might recur. They should, however, be near enough to each other to grip the cord (Fig. 28). The precise point to which the cord is transplanted depends upon the condition of the muscles at the internal abdominal ring. If in this situation they are thick and firm, and present broad raw surfaces, the cord may be brought out here. But if the muscles are attenuated at this point, and present their cut edges, the cord is transplanted further out. The skin wound is brought together by an uninterrupted suture, which is withdrawn after two or three weeks. The transplanted cord lies on the aponeurosis of the external oblique, and is covered by skin only."

There are serious objections to this operation, and the results, though good, are not more favourable than those of Bassini's operation. The first objection is that the procedure is complicated, and more difficult to perform than Bassini's operation, and the length of time occupied by the operation thereby needlessly increased. The second and more serious objection is the effect on the cord and the testis. O'Conor (*Lancet*, Aug. 26, 1899) says that in 80 per cent. of his cases treated by Halsted's method orchitis followed, and in 20 cases out of 129 atrophy of the testis resulted. This may be traced either to the superficial position of the cord, or to the free removal of spermatic veins.

(9.) *Method of Kocher.**—This method is worth noting, as it is claimed that by it the sac is stretched in a direction opposite to that of the inguinal canal and the course of the hernia; and that when the sac is fixed *in situ*, this is done more firmly and in a more permanent manner than by other methods.

The skin and superficial fascia are divided over the canal. At the external ring the inter-columnar and cremasteric fasciæ are divided, and the sac defined. This is then carefully isolated from adjacent structures, and strongly pulled down so that its pedicle may be exposed. The left index finger is now introduced into the inguinal canal, and to one side of the internal ring a small opening is made through the aponeurosis of the external oblique; a slender pair of artery-forceps is passed through this opening and through the lower muscular fibres of the internal oblique and transversalis, following the left index as it is withdrawn, through the inguinal canal, and finally out of the external inguinal opening. With these the isolated sac is grasped and drawn throu the canal, and out at the small opening in the aponeurosis of t external oblique (Fig. 30). It is then drawn out as much as possible and energetically twisted. It is next strongly drawn down and lai over the outer surface of the ex ternal oblique and outer ring, i the direction of the canal. B this tension of the sac the anterio wall of the unopened canal i pressed backwards into a gutter Deep sutures are now applied being passed above the twiste sac, through the aponeurosis o the external oblique and the internal oblique and transversalis, through the sac itself, and taking up Poupart's ligament below (Fig. 31). In the case of a long sac, all that extends below the outer ring is cut away.

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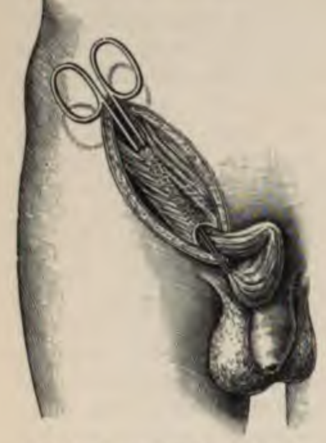
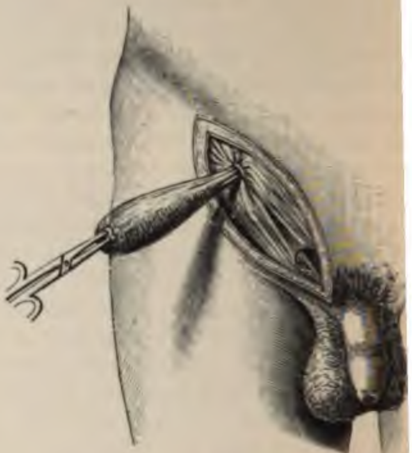
* *Ann. of Surg.*, 1892, vol. ii. p. 524.

FIG. 29.



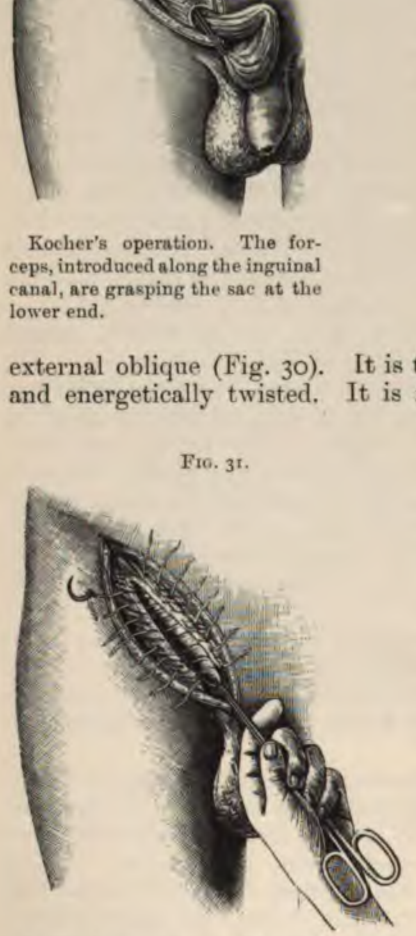
Kocher's operation. The forceps, introduced along the inguinal canal, are grasping the sac at the lower end.

FIG. 30.



Kocher's operation. The sac is draw out through a small opening in the extern oblique aponeurosis.

FIG. 31.



Kocher's operation. The sac having been twisted, is laid down upon the aponeurosis of the external oblique. Eight deep sutures are also shown.

It is claimed that by this method the sac is firmly drawn on the stretch, and securely pressed over the entire length of the canal, so as to form a solid pad or roll. The deep sutures would appear to be passed somewhat in the dark, as regards the cord.

(10.) *McBurney's Method.*—This is different from all others described, in that, instead of trying for primary union, the wound is made to heal by granulation tissue.

The sac having been reached by an incision exposing the whole canal and external ring, is separated and tied as high up as possible. The part below the ligature is then cut away. In order to keep the wound an open one, the superficial are then stitched to the deep parts; next, skin and conjoined tendon above, skin and Poupart's ligament below, are sutured together. The wound is then packed with iodoform gauze. The wound is thus made to fill up by granulation tissue, producing a thick scar, which McBurney believes to be the best guard against relapse.

RADICAL CURE OF FEMORAL HERNIA.

There is less necessity for operative interference here—women, in whom the above variety is so much more frequent, finding a truss more efficient and less irksome, owing to their less active life and their mode of dress. In omental hernia, where there is difficulty in fitting or unwillingness to wear a truss, in irreducible hernia, and in all cases of strangulated hernia, where the patient's condition and the surroundings of the operator admit of it, an attempt should be made to cure the hernia permanently. We are met here by a difficulty less present in inguinal hernia—*i.e.*, that of closing the canal satisfactorily, owing to the scantiness of some of its immediate surroundings and the importance of others.

Different methods :—

i. The empty sac having been thoroughly separated from its surroundings—a step here usually carried out with ease—is twisted up tightly, transfixed, and tied with reliable catgut, and then thoroughly invaginated within the femoral ring.

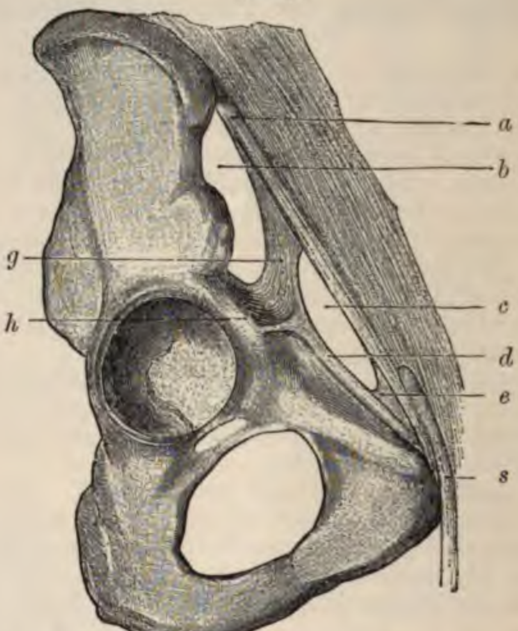
ii. Kocher's method (p. 77) may be employed. The empty sac having been isolated and twisted as strongly as possible, is drawn through a small opening made above Poupart's ligament, and, much as described at p. 78, included in sutures which are passed through the pectineal fascia and Poupart's ligament with the hope of closing the femoral canal.

iii. The sac may be treated much as in the methods of Barker and Bennett (pp. 72 and 73). Thus, after it has been isolated and emptied, the neck is thoroughly cleared with the finger passed up the femoral canal. The neck is now ligatured as high up as possible, the body of the sac cut away, and the ends of the ligature, which have been left long around the neck of the sac, are carried up the femoral canal by means of needles on handles along the index finger, and made to emerge in front of the peritonæum through the external oblique aponeurosis just above Poupart's ligament, about half an inch apart. When these are tied the sac will be invaginated. While the above ligatures are being passed one assistant should protect the femoral vein, while another draws up the upper angle of the skin incision so that the needles may emerge in the wound.

The above refers chiefly to treatment of the sac. The other cardinal step in the radical cure of femoral hernia—closure of the femoral canal and ring—is much more difficult here, for reasons above given. Fortunately trusses are much less of an infliction here, and thorough obliter tion of the sac on some of the lines I have described will, with the ai of a light-fitting truss, suffice amply. Where it is desired to go furthe and close the femoral ring and canal, one of the following methods ma be made use of.

iv. *Lockwood's Method** (Figs. 32, 33, and 34).—The stump of the sa is first drawn up and fixed as above described. The subsequent ste are described by the author as follows: "For this purpose the inde finger of the left hand is pushed up the femoral canal so that it lie with its dorsum against the common femoral vein, and its tip upo and a little within the ilio-pectineal ridge. The finger is intended t

Fig. 32.



a, Poupart's ligament. *b*, Lacuna muscularis. *c*, Lacuna vascularis. *d*, Cooper's ligament. *e*, Gimbernat's ligament. *g*, Ilio-pectineal ligament. *h*, Ilio-pectineal eminence. *s*, Spermatic cord. (Lockwood.)

protect the vein from the point of the herniotomy-needle, and to guide the latter as its point is thrust beneath Cooper's ligament (*vide* Fig. 32). In cases in which the femoral canal has been distended and stretched, the needle can be guided by vision. The herniotomy-needle is passed in the following manner:—Having been armed with about one and a half feet of No. 4 or 5 twisted silk, its point is guided up the femoral canal until it rests against the inside of the linea ilio-pectinea, opposite the outer edge of Gimbernat's ligament. The needle is then rotated so that its point scrapes over the linea ilio-pectinea and picks up Cooper's ligament. Finally, the point emerges through the upper part of the pectineal fascia, where it is unthreaded and withdrawn, leaving the suture beneath Cooper's ligament (*vide* Fig. 33). Additional sutures are passed in exactly the same way, but each a little farther outwards until the last lies at the inner edge of the common femoral vein. Two or three sutures generally suffice, but I have used as many as five. The next step is to again thread the upper end of each ligature in turn through the herniotomy-needle, and, by pushing the point of the needle half-way up the femoral canal and rotating it forwards, pass the thread from within outwards through Hey's ligament close to its junction with Poupart's ligament (*vide* Fig. 33). Before knotting these threads they are pulled tight, to see whether enough have been passed to make a thorough and firm closure of the femoral canal, but without compressing the femoral vein (*vide* Fig. 34)." The final results of Mr. Lockwood's cases are not fully given, owing to the difficulty in following them up. Ten cases, however, are mentioned. In nine of these the result was satisfactory after periods varying from one to seven years; the tenth case relapsed suddenly at the end of six months.

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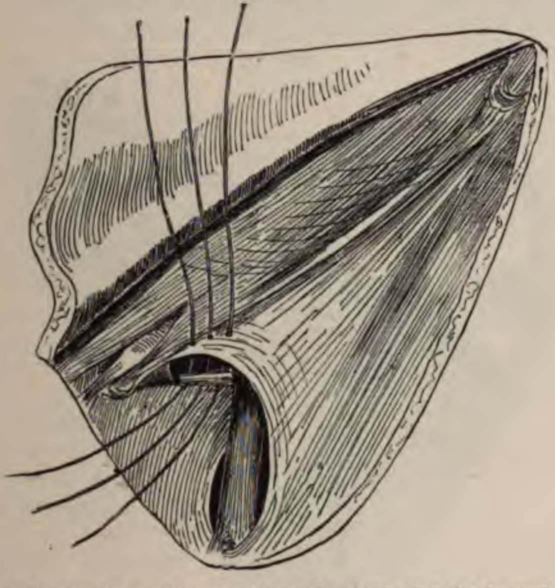
* *Hernia, Hydrocele, and Varicocele*, p. 192.

FIG. 33.



Lockwood's operation. Showing the mode of suturing the femoral canal.

v. *Bassini's Method.* — After high ligation and removal of the sac, the canal is closed in the following manner:—Three sutures are passed through Poupart's ligament and the pectineal fascia. These are left untied while three or four more sutures are inserted and tied. These unite the falciform ligament to the pectineal fascia, the lowest being placed close to the saphenous vein. Bassini has published fifty-four cases operated upon by this method, without any recurrence in forty-one cases, traced from one to nine years.

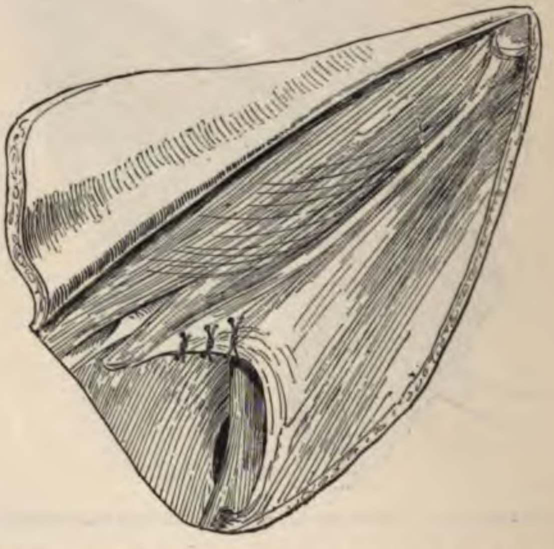
RADICAL CURE OF UMBILICAL HERNIA.

This operation is rarely called for: in children the natural tendency to cure is very marked; and in adults, the kind of patients usually me with—stout women of middle age with damaged viscera, bronchitis, &c —are not suitable for operative interference, save after the operation for strangulation (p. 49).

Treatment by operation may be considered under the following heads:—

i. In Congenital Hernia of the New-born Child.—In these cases, either herniæ into the root of the cord, or (from deficiency of the abdominal walls) partial eventrations, interference is often out of the question from the co-existence of other malformations. If the hernia be uncomplicated, and the child appear likely to survive otherwise, an attempt should be made by abdominal section to return the contents, refresh the edges of the opening, and unite them with sutures.

Fig. 34.



Lockwood's operation. Showing the closure of the femoral canal completed.

ii. In Infantile Hernia—the common form in children.—In those rare cases, where the wearing of a truss has not been sufficient, an operation may be performed with excellent prospects of success. A simple method is to explore the hernia, reduce the contents, and then, after cutting away superfluous sac and scar tissue, to unite the different layers—peritonæum, fibrous tissues, and skin—by separate layers of sutures.

In cases where a pedicle can be made to the sac—not always, from my experience, an easy matter, owing to the directness and shortness of the opening—it may be twisted and invaginated as advised at p. 70, and the other structures sutured over it, or it may be invaginated after the method of Barker (p. 72) or Bennett (p. 73). Another method is that of Mr. Keetley (*Ann. of Surg.*, Sept. 1887). The sac having been separated and twisted as in Mr. Ball's method (p. 70), a stout catgut suture is passed through it, and the peritonæum being very carefully separated from the linea alba above the ring, a needle is passed up into the space thus made, carrying the catgut, threaded, through the sac, and brought out through the linea alba. Then, on pulling the catgut tight, the twisted sac is drawn into the space between the peritonæum and the linea alba. The edges of the hernial aperture, now freed, are pared and brought together with pins and twisted suture.

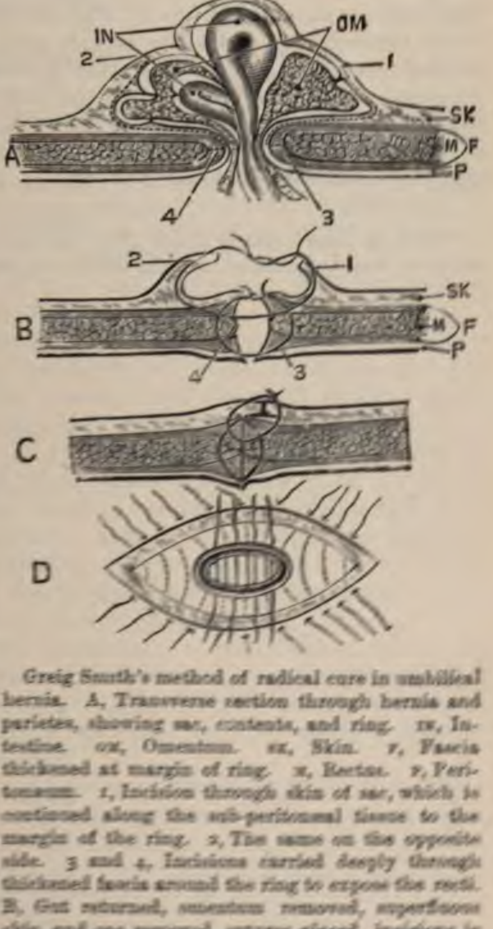
For those cases of adult umbilical hernia where the age and the condition of the patient as to her lungs and other viscera are sufficiently favourable, and where a truss or belt is found useless, the operation already recommended in herniotomy for strangulation (p. 49), and the steps for taking away the sac and redundant skin and suturing the ring, will be found sufficient.

Other methods are those of the late Mr. McGill, of Leeds, who advocated (*Brit. Med. Journ.*, 1890, vol. i. p. 428) a modification of Macewen's method, *i.e.*, the formation of an internal pad made from part of the sac and fixed in the subperitonæal space over the neck of the sac. M. Lucas-Championnière, in his work on the Radical Cure of Hernia, advises that the fibrous edges of the wound be so refreshed and sutured that the edge of one side shall overlap that of the other.

The skin incision is united in the ordinary way.

The chief points to bear in mind in the radical cure of umbilical hernia are well shown in the above drawing by the late Mr. Greig Smith (Fig. 35).

Fig. 35.



Greig Smith's method of radical cure in umbilical hernia. A, Transverse section through hernia and parietes, showing sac, contents, and ring. IN, Intestine. OM, Omentum. SK, Skin. F, Fascia thickened at margin of ring. M, Rectus. P, Peritoneum. 1, Incision through skin of sac, which is continued along the sub-peritoneal tissue to the margin of the ring. 2, The same on the opposite side. 3 and 4, Incisions carried deeply through thickened fascia around the ring to expose the recti. B, Gut returned, omentum removed, superfluous skin and sac removed, sutures placed, incisions in fascia opened up and recti exposed. References same as in A. C, Sutures tied, skin-suture to one side of parietal line of junction. D, Bird's-eye view showing double set of sutures around umbilical ring and cutaneous wound. (Walsham.)

**Causes of Death and of Complications which may be met wi
after Operations for the Radical Cure of Hernia.**

1. Sepsis. 2. Peritonitis. 3. Scarlet fever. 4. Tubercular meni
gitis. This may occur in patients the subjects of other apparent
quiescent tubercular trouble—*e.g.*, spinal caries. 5. Bronchitis d
to the anæsthetic; a danger especially to be avoided in a child w
has lately had measles. 6. Pneumonia. 7. Pulmonary embolis
8. Nephritis. 9. Epididymo-orchitis. 10. Sloughing of epididym
and testicle. 11. Flatulence, with troublesome distension. Th
condition, so well known after operations on the interior of the abd
men, is known by some as "pseudo-peritonitis."* It is best met
aperients—*e.g.*, calomel gr. v. and Seidlitz powders, given alternate
every three hours, until the bowels act; or the following enema m
be useful: castor oil ℥ij., turpentine ℥j., soap and water to 8 oz. 12. R
currence. This may be due to the patient's fault, *i.e.*, his not havin
worn a truss when this was obviously indicated. More often it is d
to faulty operating, suppuration, and the resulting thin, stretchin
scar; or to stitch-abscesses and sinuses, to which I have referred abov

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* Where a large quantity of omentum has been tied close by the colon, the action
the latter may be inhibited, and the above complication follow to a marked degree.

CHAPTER III.

COLOTOMY.

UNDER this term are included the anterior iliac or inguinal colotomy of Littré, in which the sigmoid colon is opened in the left iliac region; that of opening the ascending or descending colon in the loin, or lumbar colotomy—an operation with which the name of Amussat* is justly associated; finally, the question of making an artificial anus in the cæcum or transverse colon is considered.

The question of the value of colotomy, compared with excision of the rectum, in cases of cancer is dealt with later on.

Before describing and comparing the different modes of performing colotomy I shall deal with those conditions which call for this procedure, then the advantages of the chief methods and the cases to which they are relatively adapted, describing finally the operations themselves.

Indications for Colotomy.—(1) Certain cases of malignant disease of the rectum. I say "certain cases" advisedly, for it is far too much the rule to recommend colotomy as soon as rectal cancer is detected, as if no other lines of treatment existed; and it is too much the habit of students, when they see an artificial anus neatly made in these cases, to think that now the patient's troubles are over. In reality he is probably only exchanging one set of troubles for another.

Where obstruction is present, impending, or threatening, where, in cases which are too advanced for excision, there is extensive ulceration,† great pain, difficult defæcation, loss of sphincter power, profuse blood-stained or fæco-purulent discharge from the bowel, or multiple fistulæ, the operation is abundantly justified.

In less urgent cases, if the surgeon be doubtful as to recommending this operation, he cannot do wrong if he lay stress on two points—one, that there is always the risk of obstruction setting in, and none can s how soon this may call for colotomy under circumstances much le favourable; the other, that there is just a possibility that the operatio by diverting the fæces, will arrest the rate at which the growth wou otherwise spread.

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* Students are frequently perplexed as to the difference between Amussat's and Callisen's operations. Callisen (1796) was the first to suggest such an operation as colotomy, and planned to open the descending colon by a vertical incision. This proposal was condemned by contemporary surgeons. Amussat revived the retro-peritonæal operation, if he was not the first to perform it, but modified it by extending it to the ascending and descending colons alike, and by making use of the transverse incision. Long before Amussat's time, Littré (1710) had opened the sigmoid flexure through the peritonæum, and in 1776 Pilloré had opened the cæcum.

† As a rule, the first time the surgeon examines a patient, the more the growth tends to become annular, the less limited it is to one aspect of the bowel; or the more it projects into the lumen in tuberous masses, the more likely, *cæteris paribus*, is obstruction to threaten.

As a rule, the more complete the failure of previous treatment, t more painful, difficult, frequent, and unsatisfactory the action of t bowels, the greater the tendency to distension of the sigmoid or low intestines generally, the more frequent the attacks of gripings a partial obstructions, which herald in the tormina of a complete *miserer* the younger the patient, and thus the longer the natural prospect active life, the more plain are the indications for colotomy. On the o hand, certain special evils[*] call loudly for the relief which the operatio may give—viz., a patulous or invaded sphincter allowing of involunta escape of flatus and fæces, multiple fistulæ giving rise to foul sanio discharge, keeping the patient (perhaps a woman of scrupulous cleanl ness) in a constantly filthy condition, and leading to a brawny, painf condition of the buttocks, which thus readily become the seat of cell litis and its allies; projection of the growth downwards through th anus, leading not only to a patulous sphincter and its conseque wretchedness, but also to irksome or painful sitting.

On the other hand, certain conditions contraindicate the operation—viz., exhaustion of strength, evidence of secondary deposits in th peritoneal cavity, liver, lungs, or pleura, extension to the inguin glands, and absence of much pain or obstruction from first to last.

It has been too much taken for granted, because rectal cancer is ofte a disease of much suffering, and because, from the inefficiency or neglec of treatment, obstruction does occur, that, when cancer of the rectum i diagnosed, the patient has, therefore, agonising pain and obstructio to look forward to. The above view is quite incorrect. In a fe cases cancer of the large intestine may run its course, and set up viscera deposits and kill the patient with very little pain, and no threatening o obstruction[†] whatever; in other cases—and they form a considerabl number, and would be still more numerous if efficient treatment wer begun early and persevered with—careful attention to diet, regula use of laxatives, daily washing out of the bowel with warm water by soft catheter or œsophagus-tube passed *through* the stricture, followe by the injection of starch and laudanum, or a suppository of cocaine, iodoform, and morphia, will give great comfort for the rest of the day, entirely prevent obstruction, and enable the patient to get about and g to business almost to the last.

Other ever-important points on which the patient or the friends, especially if in a better rank of life, will frequently expect a decided answer, are—the amount of relief, and also the amount of annoyance, which will follow the formation of an artificial anus.

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[*] To quote only two special wretchednesses—*e.g.*, when a lady cannot rise from her easy-chair without an escape of flatus or fæces taking place from a powerless sphincter; or when a man is threatened with agonies of pain from the carcinoma eating backwards and involving the sacral nerves, and causing caries of the sacrum with fistulæ and foul discharge.

[†] In a few cases the growth may, instead of projecting into and obstructing the lumen of the bowel, have led by ulceration to enlargement of the gut into a cavern-like space.

The amount of relief given will depend on the amount of pain the patient has, the degree to which obstruction is threatening, or the presence of special miseries such as those alluded to above. Patients may be assured that any continuous pain will be greatly lessened in severity, if not entirely removed; that defæcation will become easy, painless, and, after the first four or six weeks, limited to one motion a day, save when diarrhœa is present; and that the distress of constant desire to go to stool, and tenesmus, will disappear.*

The other part of the question—the amount of annoyance following on an artificial anus—must be honestly met. There is too great a tendency amongst writers on colotomy to teach that, if the operation is done sufficiently early, and if its immediate risks are survived, the relief is *always* decided and the patient's condition *always* a most satisfactory one. This tendency has largely arisen from colotomy being so often performed on hospital patients whom it is so difficult to keep long under observation. While it is always right to remember that the disease is a mortal one, and that if a fair comparison is to be made, it must be not between the condition with an artificial anus and that of perfect health, but between an artificial anus and a bowel with incurable cancer, the patient's after-condition will be materially affected by his position in life. Where a patient's remaining days are easy, where he can continue to be careful in his food to avoid diarrhœa, where he can pay regular attention to the opening, this may give little annoyance; and it is also a rule that the greater the miseries of pain, and frequent and difficult defæcation from which the patient has been relieved by colotomy, the more easily does he forget any annoyance of the anus in his relief at what he has escaped from in the past. But, on the other hand, where the surroundings of the patient compel him to try and work, the friction of any prolapsed bowel which follows on movements of the thigh and groin, the difficulty of paying attention to the opening, of avoiding diarrhœa from unsuitable food, of washing out the lower bowel—all these may mean that colotomy has only enabled the patient to exchange a life of miseries for one of annoyances—the annoyances of the opening for the miseries of the disease; annoyances certainly less important but not the less present to the patient because they were unexpected. And, as I have said before, the less urgent the conditions for which the colotomy was done, the less the patient has been relieved from, the more actively will the annoyances of the artificial opening be present to his mind. The more frequently a surgeon performs this operation, the more readily will he admit that there are cases in which colotomy, though well performed, fails to give the expected amount of relief.

Putting aside cases where the operation is performed too late, and where the local mischief has been allowed to become too advanced, those where secondary deposits exist, cases where the opening has been too free, or where, with a proper opening, a constant cough, aided by a relaxed condition of tissues, tends to bring about a worrying prolapsus, —putting aside cases in which the opening was perhaps originally too small, or in which the patient does not take the trouble to keep the opening dilated as directed,—I am of opinion that occasionally cases of failure to give complete relief are met with after an operation quite properly carried out. While I cannot give, and have failed to meet, an explanation for every case, I think the following are *bonâ fide* causes, and without detracting seriously from the value of this excellent operation, because only occasional, I feel that they have been somewhat unduly overlooked.

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* *I.e.*, if the opening is free, if there be a good "spur," and no fæces find their way into the bowel below.

Some of these instances of incomplete relief, viz., persistent passage of motions over the malignant disease, and teasing diarrhœa from the artificial and natural anus, have seemed to me to be due: (*a*) To the lower communication with the bowel being too patent, sometimes no doubt accounted for by the fact that the colon, at the spot where it has been drawn into the wound, owing to the shallowness of the loin or the length of the meso-colon, is scarcely kinked or bent at all; this leads to escape of fæces over the malignant growth, and much pain and teasing diarrhœa. (*b*) To persistence of the growth in the bowel below, causing a profuse sanious discharge. (*c*) To the growth extending upwards towards the wound, or to the bowel having been opened only just above the growth.

(2) Venereal or syphilitic stricture of rectum, in which previous treatment, including dilatation, has failed, and in which proctotomy* is not available.

Much of what has been written above of colotomy for malignant disease of the rectum applies to the operation here also. There is one reason for resorting to it earlier, which may occasionally arise, and that is where the patient is young, and colotomy is called for by extensive ulceration, it is possible that with the rest given by the operation the above condition may be healed, and the artificial opening closed later on.

(3) Pelvic tumours—*e.g.*, enchondroma or sarcoma—pressing on the rectum.

(4) Results of pelvic cellulitis narrowing the rectum.†

(5) Vesico-intestinal fistula.

Colotomy is performed in cases of communication between the large intestine, especially the rectum, and the bladder, to prevent the passage of fæces into the bladder, with its results of cystitis, agonising obstruction of urine, and passage of flatus from the urethra without notice and beyond control.

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* Linear division of a non-malignant stricture posteriorly. If a finger cannot be passed through the stricture, this is first divided with a probe-pointed bistoury to admit the finger. Then a curved, sharp-pointed bistoury, passed through the stricture, is made to transfix the bowel beyond the stricture, and the point is brought out close to the tip of the coccyx. The parts are then cleanly divided by cutting out towards the anus in the middle line. Most strict antiseptic precautions are necessary. In about ten days the use of bougies is commenced.

† This, though rare, is occasionally an undoubted indication for colotomy. I still see from time to time a woman on whom Mr. Howse, over eighteen years ago, performed colotomy for urgent obstruction due to the contraction of the bowel brought about by pelvic cellulitis. More lately I have had under my care a woman, aged 23, a patient of Dr. Howell's, of Wandsworth, on whom chronic obstruction had been brought about by the same cause, dating here to the birth of an illegitimate child. The ring of contraction round the rectum was here so marked, that carelessness in diet or neglect of the use of bougies will, I am certain, lead to colotomy being ultimately called for. The possibility of the mischief in these cases being gummatous must always be remembered.

Such a fistula is much more frequently met with between the sigmoid or rectum and the bladder; if between the latter and the rectum, the communication may be found by the finger, or by passing a duck-bill speculum and injecting coloured fluids.* Too frequently malignant in character, it is occasionally of a simpler nature—*e.g.*, dysenteric, &c., —and so, perhaps, curable. Thus, in Mr. Holmes's case (*Med.-Chir. Trans.*, vols. xlix. and l.) the ulceration between the sigmoid and the bladder was not malignant, colotomy for fifteen months was most successful, but a permanent cure was prevented by similar ulceration taking place between the cæcum and bladder, which caused death. Whether the cause is malignant disease or no, the life which lies before the patient is scarcely tolerable.

The opening is far more frequently valvular in nature—*i.e.*, while it admits of the passage of fæces into the bladder, urine very rarely passes per anum.

(6) Colotomy (iliac) is usually performed on the left side in cases of malformation of the rectum, when this part of the intestine cannot be found by a dissection in the perinæum. It has been disputed in these cases whether, after an unsuccessful exploration in the perinæum, an iliac or a lumbar colotomy should be performed. The great majority of surgeons have preferred the former operation, following here Mr. Curling (*Diseases of the Rectum*, p. 228). This surgeon pointed out that the lumbar operation was contraindicated on the following grounds:—(α) The death-rate is relatively greater; (β) the kidney, varying in size at this time of life, may, when large, overlap the colon; (γ) the colon, instead of being distended with meconium, as might be expected, is sometimes contracted and very hard to find; (δ) in addition to the irregularities in the position of the colon which have already been mentioned, a meso-colon is frequently present.†

Mr. Morrant Baker,‡ as far as I know, was the only surgeon who has of late years advocated the lumbar operation in cases of imperforate rectum. His reasons appear to be that he thinks Amussat's operation gives these cases "a good chance of an unwounded peritonæum," and that those who think Littré's operation the better one do so on insufficient grounds. It is noteworthy that Mr. Baker's case, though most successful, the patient being alive when last heard of, nearly three years after the operation—was not sent to him till the nineteenth day after birth, when "the abdomen was enormously distended, and the vomiting frequent, and the child much exhausted." No doubt, if we could always thus defer operating in these cases, lumbar colotomy would be rendered much safer, but the peril of the children would be much increased. But from my experience at Guy's, and the Children's Hospital with which I was connected, the surgeon is called upon to interfere long before this.

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* The following plan, based upon one made use of by Mr. Lund (*Hunt. Lect.*, 1885, p. 91), would very likely be useful—viz., to pass into the rectum a bougie round which is wound a strip of lint well soaked in starch-and-water and dried, and then to inject into the bladder some diluted iodine solution. A stain of starch iodide on the bougie would show the position of the fistula.

† Mr. Curling (*loc. supra cit.*) gives the results of twenty dissections on the bodies of infants, both operations having been first performed. In eighteen out of the twenty, Littré's operation was found easy, whether the bowel was distended or no. In two, this operation failed, as the colon crossed the spine to run down, on the right side, into the pelvis. In eight out of the twenty subjects, lumbar colotomy was easily performed, without opening the peritonæum. In six, the operation was "more or less difficult," and, as Mr. Curling remarks, the difficulties would have been increased in the living. In six, lumbar colotomy was impossible owing to the distinctness and looseness of the meso-colon.

‡ *Clin. Soc. Trans.*, vol. xii. p. 240.

The question was raised by M. Huguier,* whether, when the inguinal operation was going to be performed, the right side should not be chosen, as he considered that on this side the surgeon was more certain to reach some part of the large intestine. M. Giraldès,† on the other hand, has stated that all the inquiries undertaken to elucidate this subject tend to show clearly that the surgeon may rely on finding the sigmoid in the left groin. "Numerous anatomical investigations, together with the records of those of Curling and Bourcart, have shown me that in the great majority of cases in the fœtus and newly-born child the sigmoid flexure is placed on the left, and not on the right. In 134 autopsies below the age of a fortnight I found the sigmoid flexure on the left side in 114; in 50 cases of Littré's operation which I have collected the operator always met with the sigmoid flexure on the left side; in 30 post-mortem examinations of infants operated on for imperforation the intestine was always found on the left; in 100 examinations of new-born children Curling found the sigmoid flexure on the left side 85 times; and Bourcart, who made prolonged researches in order to elucidate this question, found the sigmoid flexure in its normal position 117 times out of 150."

(7) Dysenteric ulceration and stricture. The treatment of dysentery leading to stricture is rare: when it occurs, ulceration may extend so high up the large intestine as to make even a right-sided colotomy of doubtful value. A case of colitis (the nature of this is not explained) with ulceration, treated by inguinal colotomy and local treatment of the ulcerated surfaces, with subsequent closure of the artificial anus, is recorded by Mr. Mayo Robson (*Clin. Soc. Trans.*, vol. xxvi. p. 213). In patients who give a history of long-standing dysentery and stricture, dysentery is often the result and not the cause of the stricture.

(8) Annular stricture of the sigmoid colon.

(9) Malignant disease of the large intestine higher up—viz., in the splenic or hepatic flexures.

(10) Membranous colitis. Mr. Golding-Bird has described two cases in which he has performed right lumbar colotomy for membranous colitis, with the object of giving rest to the colon. In the first case (*Clin. Soc. Trans.*, 1896) the colotomy was closed after five weeks, as all symptoms had disappeared. The patient remained quite free from symptoms of colitis until her death, which took place two months later. In the second case (*Guy's Hosp. Gaz.*, March 5, 1898) the patient was quite relieved, and was fat and well nine months after the colotomy was performed.

Dr. Lawrie, of Weymouth, has also published a successful case (*Brit. Med. Journ.*, Nov. 5, 1898). The patient was 47, and had a history of membranous colitis of eleven years' duration. The cæcum was opened on January 17, 1897, the wound being kept open for seven months. The patient was well in February, 1898.

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* *Bull. de l'Acad. de Méd.*, tom. xxiv. p. 445.

† *Leçt. Clin.*, p. 121. Quoted by Mr. Holmes (*Dis. of Children*, p. 179).

As a much rarer indication for colotomy this deserves mention, viz.:

(11) Cancer of the tail of the pancreas obstructing the splenic flexure. Mr. Beck records a case of this kind (*Lancet*, vol. ii. 1887, p. 113):

> When the descending colon was opened neither gas nor fæces escaped, although the abdominal tension caused the gut to protrude through the wound. The finger inserted into the colon could not reach the seat of obstruction. The ascending colon was accordingly opened, and a large quantity of gas and liquid fæces at once escaped. The operation gave great relief, but death took place suddenly (unexplained by the necropsy) seventeen days later.

Of the above eleven conditions, the first five will usually be treated by inguinal colotomy, this operation being preferred for the reasons mentioned below (p. 101), as long as the abdomen is undistended. The operation chosen in the seventh must depend on the height to which the disease has extended. In the eighth the surgeon will be justified in cutting down upon the sigmoid colon, with the intention of excising the disease if possible. or opening the bowel above it, lumbar colotomy being only resorted to if neither of the above courses is found feasible. In the last two it will be needful to open the colon high up. It will be well to discuss here the difficulties which often arise in deciding as to

The Site of the Proposed Colotomy.—In the above cases, especially where intestinal obstruction is threatening from malignant disease with distension and tympanites, the surgeon, particularly if the history is deficient or misleading, may be in doubt as to the site of the disease, and therefore where to operate. It is quite impossible to make fixed rules for advice, but the following points will help in doubtful cases. Before specifying them I would call attention to two points: one, that malignant disease quite low down—*e.g.*, in the sigmoid—may, by a sudden onset of obstruction, simulate an acuter condition of things higher up, the patient being too ill, or otherwise unable, to give an account of previous threatening and finally culminating obstructions. Here the following alternatives lie before the surgeon: (1) to explore the site of obstruction through the linea alba; (2) to cut down upon the sigmoid flexure in the hope that the obstruction may be in this neighbourhood, a very common place; (3) to perform right lumbar colotomy, so as to make sure of relieving any obstruction further back—*e.g.*, in the splenic or hepatic flexures. I would here warn my junior readers on two or three points. If they decide first to explore by abdominal section, and find a growth in the colon, descending or ascending, they should not, even if the meso-colon admits of it, bring the bowel into the middle line and open it. Making an artificial anus in the colon by a median incision is usually a matter of difficulty, the bowel not coming sufficiently up into the wound; thus the skin has to be forced down to it, causing tension on the sutures, giving way of these a little later, and either disastrous results or a most unsatisfactory opening. Even if it were usually easy to carry out the above course, I do not consider it would be good surgery, as such displacement of the large intestine may lead to acute obstruction of some loop of the small intestine later on.

I also advise against opening the cæcum if this can be avoided. Owing to the more liquid nature of the fæces here from the close proximity of the small intestine, though the patient's nutrition will not suffer, the skin in the neighbourhood of the artificial anus is liable to most troublesome excoriations and ulceration.

In cases where the surgeon is in doubt as to the exact site of the disease, but suspects, from the age of his patient, duration of the trouble, history of "indigestion" with unsatisfactory action of the bowels, number of attacks of threatening obstruction, &c., that the mischief is somewhere in the large intestine, attention to some of the following points may be useful:

(1) The proportionate *frequency of stricture in different parts of the large intestine.* The frequency of disease in the rectum and sigmoid flexure, as compared with any other part of the large intestine, and, generally speaking, the frequency of disease in the left side of the arch formed by the large intestine, as compared with such disease in the right side, are well known.*

(2) *The use of large injections.* Dr. Fagge (*loc. supra cit.*, p. 318) thus writes on this subject:—"Several writers, and especially the late Dr. Brinton, have laid stress on the value of large injections as an aid to diagnosis. The observer I have named has even laid down definite rules for our guidance in this respect. 'It is quite singular,' he says, 'how trustworthy I have found the conclusions thus arrived at. For example, with a maximum injection of a pint of warm, bland liquid the obstruction in an ordinary male adult may be referred to a point not lower than the upper third of the rectum. A pint and a half, two pints, three pints, belong to corresponding segments of the sigmoid flexure. The descending and transverse colon accept a larger, but more irregular, quantity. In one case, in which it was evident that the stricture occupied the upper part of the ascending colon, nine pints of injection were always found to be the maximum.'" Dr. Fagge points out that the correct determination of this point requires much care, as (*a*) some of the fluid measured may escape in the injection; and (*b*) a stricture may be pervious to fluid injection from below, though the intestinal contents may be unable to pass through it from above. Thus, in a case in which there was a mass of disease in the sigmoid flexure, just above the pelvis, four pints of water were injected per rectum; of this a small portion only returned, the greater part passing through the stricture and adding to the accumulations above it. I would add one more caution with regard to these injections. Patients in much misery, and having submitted to one or two rectal examinations, will sometimes ask for an anæsthetic. Such an aid must be used with great caution if there is already abdominal distension. There is not only a danger of adding seriously to the distension, and thus further weakening or rupturing parts which may be already near the point at which they give way—*e.g.*, a cæcum with "distension ulcers"—but an anæsthetic, especially chloroform, has additional dangers in such cases as these, where, in a patient probably no longer young, the action of the heart and lungs is interfered with by the upward pressure against the diaphragm. The vomiting,

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* Dr. Fagge, in drawing attention to this fact (*Guy's Hosp. Reports*, 1868, p. 314), quoted the following statistics from Dr. Brinton:—"Of 100 cases, 4 are in the cæcum, 10 in the ascending colon, 11 in the transverse colon, 14 in the descending colon, 30 in the sigmoid flexure, and 30 in the rectum." The statistics of Dr. Fagge and M. Duchaussoy confirm the above.

which the anæsthetic may cause, may also prove suddenly fatal, fæcal matter being sucked down into the lungs.

(3) *The distance to which a long bougie or rectal tube passes* is of very little value, and needs only this briefest mention here, because the surgeon is still called to cases in which he is assured that the obstruction cannot be in the rectum or low down in the sigmoid flexure, as a long bougie has been easily passed its full length. This fallacy, which is due to the bougie bending on itself, is more frequent than the other one in which the arrest of a bougie by one of Houston's folds misleads into the belief that a stricture exists low down.

(4) *The form of the abdomen* may help to valuable conclusions. Thus, Dr. Fagge (*loc. supra cit.*, p. 319) gives a case of cancer of the hepatic flexure in which it was observed during life that the cæcum and ascending colon were distended, and not the descending colon. Again, he observes that when the rectum or the sigmoid flexure is the seat of obstruction, the lumbar regions and the epigastrium are no doubt generally prominent, and the course of the colon is more or less plainly marked out. That these conclusions are only valuable if not too implicitly relied upon is shown by the fact that cancer of the rectum may be present, with vomiting, peristalsis, and borborygmi, and yet there may be no general distension of the abdomen, no filling out at all of its sides; on the other hand, a prominent epigastrium, and the appearance of a large horizontal coil of intestine here, may lead to the conclusion that the transverse colon is distended, the disease being, nevertheless, in the ileum, a distended coil of which has rivalled the colon itself.

(5) A symptom of some value, if verified by the medical man himself, is the fact that for some time the *motions* have been *narrow, tape-like, broken up, abnormal in bulk, shape, and length.* Certain fallacies diminish, however, the value of the above—*e.g.*, that in cases of stricture high up, as in the upper part of the sigmoid flexure, there is probably room for the fæces, after they have got through the stricture, to collect, till their characteristic form is given them, though we do not know how far irritation of the intestine and formation of mucus at the seat of the growth may interfere with this.

(6) A few other points—*e.g.*, constant *arrest of borborygmi at one spot, fixed pain at one spot*, as in the right hypochondrium — may give useful indications; while others, such as a *rectal examination*, are so obvious as scarcely to need mention.

If, after weighing the above, the surgeon is still in doubt as to the exact site of the disease of the large intestine, he should not hesitate to open the abdomen in the middle line and explore for the site of the disease, or perform a right-sided lumbar colotomy. He should not be deterred from this latter step by the anatomical difficulties (*e.g.*, a more complete peritonæal coat) supposed to exist on this side. Especially where the colon is at all thickened or distended, the operation on one side is no more difficult than on the other.

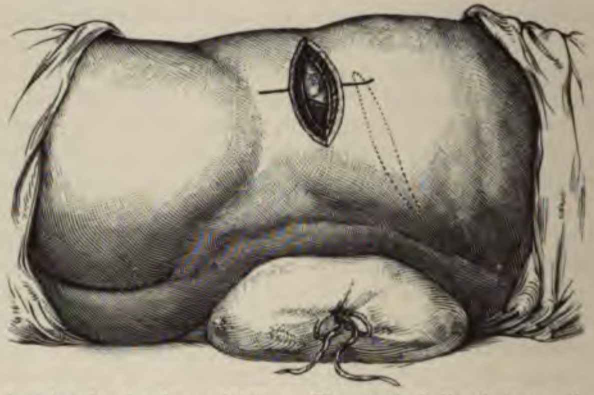
LUMBAR OR POSTERIOR COLOTOMY.

Though this operation has of late years been very largely replaced by the iliac method, it deserves attention as the operation first largely employed, and as one that has still to be resorted to under circumstances of difficulty. The indications for this operation have been already given at p. 91, and a comparison of the lumbar and iliac methods will be found below at p. 101.

Landmarks (Figs. 36 and 37).

1. The lower border and tip of the last rib. 2. A point half an inch behind the centre of the crest of the ilium, this point being found by accurate measurement along the crest between the anterior and posterior superior spines (W. Allingham). 3. A line drawn vertically up from the last-mentioned point to the last rib. This gives, with sufficient correctness, the line of the outer edge of the quadratus, and the position of a normal colon. Owing to the varying length of the last rib, the upper end of this line may meet this bone at its tip, or at a spot a varying distance in front of or behind this point. It is well to dot the ends of this vertical line with an aniline pencil. The dint of a finger-nail, made when the patient has been brought under the anæsthetic, will mark these points sufficiently to begin with, but a little later, in a difficult case, the surgeon may be glad of having taken every possible precaution.

FIG. 36.



Amussat's incision for lumbar colotomy. The vertical line between the last rib and the iliac crest is the guide described in the text. (Heath.)

Incisions.

1. Vertical, of Callisen. This at first sight is the best, as it follows the above line, and thus corresponds anatomically to the colon, but it has the disadvantage of giving but limited space, especially in a fat or deep-chested patient; and, if prolonged upwards, so as to give all the space possible, it divides the intercostal vessels running with the last dorsal nerve, and gives rise to troublesome hæmorrhage. 2. Transverse, of Amussat. 3. Oblique, of Bryant, modified from the above. One of the two latter is usually employed; they have the great advantage of being readily prolonged when more room is required, and the oblique incision corresponds better with the course of the nerves and vessels.* It is the one given below.

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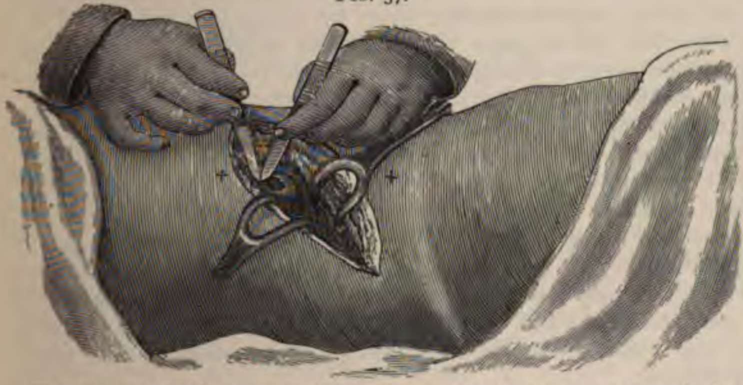
* The late Mr. Greig Smith (*Abdom. Surg.*, p. 396) gave the following practical hint:—"In thin patients, and particularly in women, whose iliac crests are more prominent than in men, there is a tendency for the upper lip of the wound to fall inwards, while the lower lip protrudes. This may be obviated by careful apposition, and by not bringing the line of the incision too close to the ilium."

Operation (Figs. 36-39).—The patient being turned on to his side (most usually the right), with a firm pillow under the loin, the parts cleansed, the tip of the last rib and the point on the crest of the ilium, as given above, being dotted with an aniline pencil, an incision is made, beginning 2½ to 3 inches from the spine, according to the size of the erector spinæ a little below the last rib, and running downwards and forwards for 3½ to 4 inches towards the anterior superior spine. The centre of this incision should bisect the line given above as the line of the colon.

The first cut should expose the muscles, the skin in the posterior half being thick, and the subcutaneous fat often abundant. The next may go well into the muscles, the remainder of which should then be carefully divided with the knife, so as to expose the fascia lumborum; any bleeding vessels being now secured, this fascia is pinched up, nicked, and slit up on a director. Two retractors being placed on the lips of the wound, the fat which lies around the kidney and behind the fascia lumborum is next torn through and pulled away with the fingers. If the bowel is distended, it will bulge up into the wound, pushing before it the transversalis fascia, and the operation can be readily completed. If, on the other hand, the bowel is empty, the real difficulties of the operation only begin at this stage. The wound being well opened, the kidney, if it come down below the rib (as it occasionally does, especially in a patient breathing heavily under the influence of an anæsthetic), being kept out of the way by the finger of an assistant, the intestine is sought for by scratching with a director, or two pairs of forceps, through the transversalis fascia (Fig. 37), exactly in the line to which attention has been already drawn. Several layers of cellular tissue may be met with here, and it is now that most of the difficulty is usually met with, owing to the operator being afraid of the peritonæum, and to his not opening the transversalis fascia with sufficient decision. Unless this point is attended to the colon cannot bulge satisfactorily or be drawn up into the wound.

FIG. 37.



The surgeon, having opened the lumbar fascia, is dissecting through the transversalis fascia to the colon itself. The two crosses mark Allingham's line.

When this has been done, scybala in the colon will in many cases be felt; but if the large intestine is empty, much trouble may be met with in detecting it and getting it up into the wound, especially if, close by, the peritoneum is bulging up.

At this stage the following points may be usefully remembered:—

(*a*) The exact position of the line of the colon (p. 94). (*b*) The lower end of the kidney, and its relation to the colon. (*c*) The outer edge of the quadratus lumborum (p. 94). (*d*) The sensation of thickness as given to the fingers in pinching up the colon, thus distinguishing large from small intestine. (*e*) The feel of scybala if present. (*f*) Seeing one of the three longitudinal muscular bands which distinguish the colon.[*] (*g*) Inflation with air or injection of fluid.[†] (*h*) Mr. Bryant has advised rolling the patient over on to his back at this stage, so that the colon may be felt to fall on the finger inserted deep into the wound.

The bowel having been found, its posterior surface is to be drawn well up into the wound. This is one of the weak points of the lumbar operation. Owing to the shortness of the meso-colon and the fixity of the bowel, especially when distended, it is very difficult to get the bowel out of the wound sufficiently to make a satisfactory " spur." Unless this is done there is a risk of the patient having a fæcal fistula instead of an artificial anus. If the case is not an urgent one, the bowel, when well pulled up, may be retained there by means of a rod passed beneath it as described below (page 104). If the shortness of the meso-colon prevents the use of a straight rod, this must be suitably curved, so that the bowel may still be kinked, but without undue tension. The margins of the wound are then carefully closed with silver wire or salmon gut sutures, and a few fine ones may be passed between the bowel itself and the margins of the wound. The usual antiseptic dressings are then applied, iodoform being dusted over the bowel and wound. These dressings will probably not need changing till the fourth day, when the operation is completed by opening the bowel with a tenotomy-knife. This opening may be a small crucial one. Very little but flatus will pass at the time, but a director will show the presence of fæces, and mild aperients may be given as soon as the parts are firmly healed.

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[*] Mr. H. Allingham (*Brit. Med. Journ.*, April 28, 1888) seems to consider it very difficult to ensure finding one of these bands without opening the peritonæal cavity. While I should be the last to make light of the difficulties which may beset this operation, I feel sure that few surgeons, who have had a large experience of colotomy, will agree that the above step is needful, especially if the line given by Mr. Allingham's father be strictly followed. Where the operation is done in two stages the peritonæum may be opened, if needful, without any drawback. But where the bowel must be opened at once—and this will be the rule in lumbar colotomy—any injury to the peritonæum is to be avoided. The aphorism quoted at p. 53 is to be remembered here also.

[†] Air is most readily made use of. It may be pumped in by a Higginson's syringe, a Lister's hand-spray, but, best of all, by the special apparatus described by Mr. Lund (*Lancet*, 1883, vol. i. p. 588), which, by means of an elastic ring, secures air-tight contact with the anus while air is being pumped in, either as an aid in colotomy or as a means of reducing an intussusception. In some cases of cancerous disease of the rectum it will be very difficult to introduce any nozzle for inflation beyond the disease. In the summer of 1885, when performing colotomy at Guy's Hospital in a patient the lower part of whose rectum had been unsuccessfully excised at another hospital, I found it impossible to introduce any nozzle when desirous of inflating an empty colon.

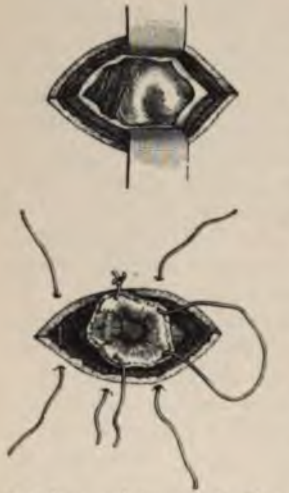
The **method of performing colotomy by two stages** was introduced at Guy's Hospital by some of my senior colleagues, Mr. Bryant, Mr. Howse, and Mr. Davies-Colley, being based on that most important modification of gastrostomy which Mr. Howse was the first to make use of in this country, Mr. Davies-Colley bringing before the Clinical Society, in 1885 (*Trans.*, vol. xviii. p. 204), a paper on "Three Cases of Colotomy with Delayed Opening of the Intestine." The great advantages of this two-stage method are (1) that it defers the opening of the bowel till this is sufficiently adherent. (2) By this delayed escape of intestinal contents the gravity of any injury to the peritonæum at the time of the operation is very much diminished. (3) The second great trouble after colotomy—that of burrowing suppuration up and down the planes of cellular tissue, which have of necessity been freely opened—is done away with. The opening of the intestine being delayed, primary union, to a very large extent, can be secured, especially with the aid of deeply-passed sutures, or of chromic gut ones cut short and dropped in, and dry dressings.

But, nowadays, under the conditions in which lumbar colotomy is usually resorted to—viz., obstruction and distended intestine—it will be necessary to complete the operation at one stage. Here the distension, and the difficulties consequent upon it, are best met by tying in a Paul's tube. The wound having been closed as far as is possible, the intestine is drawn out, and the surrounding parts are shut off with sterile gauze; a small opening is then made in the intestine, the tube inserted and tied in, and the patient turned on to his back while the chief of the accumulation in the intestine is allowed to run away safely. When sufficient relief has been given, the bowel may be additionally secured by some sutures between it and the lips of the wound. The wound having been carefully shut off with dressings, the fæces are collected by means of india-rubber tubing fitted on to the tube, soiling of the dressings, &c., being prevented by jaconet.

If a Paul's tube is not at hand, the bowel must be well drawn out of the wound and carefully isolated by means of plenty of iodoform gauze. The patient being then turned on his back and brought over the edge of the table, the wound is carefully shut off with temporary dressings, and the bowel opened either by a trocar of calibre sufficient to admit a piece of drainage-tube if the contents are fluid, or by an incision into the gut, which is well pulled out and held over some appropriate receptacle for the escaping fæces. While these are coming away the wound should be carefully irrigated. As soon as the chief distension has been relieved, the opening should be temporarily closed, while the colon, now somewhat collapsed and easier to deal with, is carefully sutured, with silk that is not too fine, to the edges of the wound, which is well dusted with iodoform, or painted over with iodoform and collodion. If the distension be not sufficiently relieved, the means for temporarily closing the colon must be next removed, and the wound, which has been carefully closed and sealed around the opened colon, kept as clean as possible by frequent dressing. The parts around must be kept smeared with an ointment of eucalyptus and vaseline, while the dressings themselves are kept in position by a many-tailed bandage, by which means they are readily and painlessly renewed.

The old operation of opening the bowel at once was easy but perilous (*vide* Fig. 38). A ligature having been passed first through one lip of the wound, then across the bowel and through the opposite lip, and another in the same way about half an inch from the first, an incision three-quarters of an inch long was then made into the gut, over these sutures, their centre hooked up into the wound, and the four halves tied on either side, a few other sutures being put in between the cut bowel and the wound. But in this case there was always some risk of fæcal matter or flatus being forced into the different planes of cellular tissue, especially if the bowel was much distended, even if precautions were taken to keep the knuckle well up, and to close the wound thoroughly around it.

FIG. 38.



Lumbar colotomy, showing the old method of opening and fixing the colon. (Heath.)

If the bowel is full of scybala no attempt should be made to remove them; they may be left until aperients can be safely given. At times the bowel seems so empty as to suggest a failed operation: there is no occasion to be troubled at this; the contents will pass shortly.

Difficulties in Lumbar Colotomy.

1. An empty bowel.[*] This has been already alluded to (p. 95). 2. Mistaking bulging peritonæum for colon, and opening it. This may be due to the surgeon forgetting the line of the bowel, and working deeply too far forwards; or it may take place from no fault of the surgeon, being due to the presence of a meso-colon, or to the extremely contracted condition of the colon.[†] It by no means always

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[*] It is noteworthy that the intestine may be found empty, even in obstructions of long continuance. Thus, Mr. Curling (*Diseases of the Rectum*, p. 182) writes: "In a case of carcinomatous stricture of the rectum, in which I performed colotomy after a month's obstruction, in a woman aged 40, not only was the colon contracted, but it was actually compressed against the spine and put out of the way by the distended small intestine, so that it was impossible to reach the bowel without opening the peritonæum. No inflammation or unfavourable symptom resulted." It would have been interesting to know whether more than one obstruction did not exist in the large intestine in this case.

[†] In a case in which, owing to the extreme pain during defæcation, the patient had dreaded any action of the bowels, and had eaten very little, the colon was much contracted and lay far back. In trying to find it, I opened the peritonæum, and omentum protruded. A carbolised sponge was kept over the opening while the colon was found, the opening then tied up with chromic gut, and the colon not opened for four days. No ill result followed. As in supra-pubic lithotomy, the peritonæum may give way during vomiting. Thus, Dr. Walters (*Brit. Med. Journ.*, 1879, vol. i. p. 212) was stitching the colon to the wound when "the patient retched violently, causing the peritonæum to give way, and a coil of intestine to protrude from the anterior part of the wound. This was immediately covered with warm sponges, cleansed from the fæculent matter it had acquired by contact with the open colon, and returned." When, five weeks later, the patient sank from exhaustion, no trace of peritonitis was found at the necropsy.

causes peritonitis. When this accident has happened, as shown by the escape of a little serous fluid, the appearance of a coil of small intestine or of omentum, the opening should be at once taken up with dissecting-forceps and tied round with carbolised silk or chromic gut, and a little iodoform rubbed round the ligature. If the opening be larger, it must be closed with catgut sutures. 3. A very fat loin. This is not a very uncommon source of difficulty in elderly people who require colotomy. It must be met by a very free incision in which all the tissues are cut equally throughout (*i.e.*, not making a conical wound deep only in its very centre: this not only adds to the difficulty of finding the bowel, but also of retaining it *in situ* afterwards). To meet the additional tension and tendency of the gut to drag away in these cases, it must be more carefully secured by close stitching, especially if it is necessary to do the operation in one stage, every care being taken to prevent extravasation of fæces into the surrounding cellular tissue.* In fat people the surgeon must be prepared not only for much subcutaneous but for abundant extra-peritonæal fat also, coarse, and difficult to dissect in. If, in such a case, the colon is contracted, there are few more difficult operations. 4. Presence of a meso-colon. This may be a cause of much difficulty and doubt, and render opening of the peritonæum necessary. Where this is the case, the surgeon should always defer opening the colon if possible.

Mr. Jessop (*Brit. Med. Journ.*, 1879, vol. ii. p. 614) mentions cases in which, owing to the presence of the above, he was obliged to open the peritonæal cavity and incise the gut through its peritonæal coat. The cut edges of the bowel, brought through the opening in the peritonæum, were stitched to the skin as in the ordinary operation. No bad effect followed. Mr. Bennett May (*Brit. Med. Journ.*, 1882, vol. i. p. 940), operating on the right side, found an empty colon, "and it was only by keeping strictly in Allingham's line, and patiently searching there between the layers of a great length of meso-colon, that the intestine was reached, collapsed and empty."

5. Abnormality of colon. Every surgeon must remember cases in which the descending colon, though present, was displaced, and came down in the middle line. Occasionally part of the large intestine is actually absent.

Mr. Lockwood (*St. Barthol. Hosp. Reports*, vol. xxix. p. 256) mentions three cases in which the colon could not be found; in two its absence was verified at the necropsy, both on the right side. One of these cases is reported fully. The following are the main points:—Owing to obstruction of the large intestine, the site of which was doubtful, it was decided to cut down on the right colon. No colon could be found, and, relief being imperatively demanded, the peritonæum was opened and a loop of small intestine drawn outside the wound. Death occurred four hours after the operation, and at the necropsy the right colon was quite absent,† the cæcum being found behind the liver in the right hypochondrium, the large intestine extending from this to the splenic flexure in the usual manner.

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* As much of the wound as is possible should be closed before the intestine is opened.

† Mr. Lockwood (*Brit. Med. Journ.*, 1882, vol. ii. p. 574) explains the abnormalities of the large intestine by the fact that, during its development, it is very mobile: the cæcum occupying first the umbilical, then the left, next the right hypochondrium, and, finally, the right iliac region, abnormalities may follow its arrest at any part of its course.

If the colon cannot be found, three courses are open to the surgeon—(α) To open the small intestine through the peritonæum from the colotomy incision. The objections to this step are that it is very fatal, and that there is no telling what part of the small intestine is opened. (β) To perform colotomy on the opposite side, and, if the colon is here distended, to open it, in two stages when practicable. This is the course that should always be followed if possible. (γ) If no colon can be found, or if the part found is below the obstruction, the linea alba should be opened to admit two fingers to explore for the displaced colon, and if no colon can be found, to draw up and attach a loop of small intestine, chosen as near the cæcum as possible. Or Nélaton's operation may be performed, this being the wiser step if the patient is exhausted by a previous prolonged operation. 6. Malignant disease at the site of colotomy. This is best met by performing colectomy in appropriate cases, or by performing colotomy on the opposite side. 7. The kidney may be embarrassingly low. 8. The peritonæum may be so pushed back by ascitic fluid that it is impossible to open the gut without injuring the peritonæum (Pepper, *Lancet*, vol. i. 1888, p. 772). 9. Cases where the operation has to be completed at once, and the colon is much distended with fæces, will give much trouble (p. 97).

Troubles which may be met with after Colotomy.

1. Too large an opening in the bowel. This may lead to prolapse of the mucous membrane. If this take place to a large extent it is a great nuisance to the patient, owing to the moist, excoriated, bleeding surface which results, difficult to keep up by any apparatus. Even where the opening has been small, a good deal of prolapse may take place if there is much cough and a flaccid condition of the side.

2. Too small an opening in the bowel. This is of much less moment, as it can be readily dilated by tents. Of these, laminaria are much the most efficient; two should be inserted at a time, to effect rapid dilatation. Then the opening is easily kept patent by the occasional insertion of the little finger, and by the wearing of a proper plug. (See also p. 108.)

3. Teasing descent of scybala into the bowel below the artificial anus. This, which often renders a colotomy disappointing, is best met by bringing the colon sufficiently into the wound at first, and by keeping patent an adequate opening. If scybala still find their way down, the colon may be washed out from the anus or the wound. If these fail, the only course, and one not devoid of risk, is to open up the wound, to divide the bowel, and attach the upper end in the wound, and then to suture the lower end and drop it in. This last step can only be taken with safety if this part of the bowel is empty (p. 107).

Causes of Death after Colotomy.

These will vary somewhat according to the presence of obstruction or no. 1. Exhaustion. Especially if the operation has been deferred too long. 2. Toxic conditions probably due to the continued distension of the intestines, and the resulting absorption by the patient of poisonous material. 3. Extravasation of fæces and burrowing suppuration. This is especially liable to happen in very fat patients, in whom there is a difficulty in getting the colon up into the wound, especially if the bowel must be opened at once. As the fæces pump out under high pressure, a sufficiently* free opening should in these cases be made into the bowel after this has been secured as carefully as possible (p. 97).

4. Peritonitis. This may be due to the operation directly, or more indirectly from fæcal or purulent retro-peritonæal extravasation, or from septicæmia. Often it is not due to the operation, but to the want of it at an earlier stage. Thus, the distended bowel may have given way just above the obstruction; often it is that weak spot the cæcum which is found perforated after the stress of distension.†

5. Septic cellulitis, erysipelas, &c. These are not always preventable in an exhausted patient where it has been necessary to open the bowel at once. 6. Vomiting. This has been noticed in a few cases to occur obstinately and fatally after colotomy. Mr. Couper (*Brit. Med. Journ.*, 1869, vol. ii. p. 557) thinks that it is not an infrequent cause of death, and suspects that traction on the bowel, its proximity to the stomach, and the fact that both receive nerves from the solar plexus will account for this. 7. Broncho-pneumonia, pleuritic effusion, especially if the wound has become septic in an exhausted patient.

INGUINAL, ILIAC, OR ANTERIOR COLOTOMY.

Of late years there has been an increasing tendency for this to replace the lumbar operation in the majority of cases which call for colotomy (*vide supra*, p. 91).

The advantages claimed for the iliac operation are chiefly—(i.) It is easier. Thus, (a) the patient, being on his back, takes the anæsthetic better than when rolled on his side; (β) In a stout patient, especially, the soft parts are easier to divide, and the resulting wound less deep and more readily dealt with than one in the loin; (γ) The bowel is more easily reached, and with less disturbance of deep-lying soft parts; (δ) There is no risk of opening small intestine, or of failing through abnormality of the colon. (ii.) The peritonæum being opened of set purpose, the surgeon can examine the site and extent of the disease. (iii.) The shallower wound makes it much easier to draw out the intestine, and make a satisfactory angle and spur, or to perform colectomy. (iv.) The position of the anus renders it more easily accessible for the needful attention.

If the above advantages are considered separately, I think there is no doubt that the first (and this is the most important one) is correct. Where the colon is distended, the lumbar operation is an easy one; but where the bowel is flaccid and lies deeply far away in a fat patient, the operation, in spite of the aids given at p. 96, is one of the most difficult in all surgery. I am speaking now from an experience of twenty-nine cases of my own and a large number which I have seen performed by my colleagues. Iliac colotomy, with the thinner soft parts, the deliberate opening of the peritonæum, and the more accessible colon, is a far easier and simpler operation. The second advantage claimed—that an iliac colotomy enables the surgeon, by opening the peritonæal cavity, to examine into the site and extent of the disease—will be found an important one (as in cases of annular or limited disease of the sigmoid, when removal of the growth may be possible, or when the surgeon is uncertain as to the site of the growth, but hopes that an inguinal colotomy may open the disease above it). The third advantage is an important one in those cases where a deep wound loaded with fat makes it very difficult to bring up and anchor a lumbar colon satisfactorily. On the fourth point, on which much stress has been laid—that an artificial anus in front is placed more satisfactorily for the patient's needs than one in the lumbar region—there is something to be said on both sides. A patient with an artificial anus in front can clean this, adjust the pad, and wash out the bowel below far more comfortably. If the motions have been allowed to become constipated, and, in order to get relief, assistance must be given from without—a very real difficulty sometimes, and one requiring considerable time and attention on the patient's part—this can be done very much more easily with an anus in the iliac region. On the other hand, the passage of flatus or the effluvium of a suddenly escaped motion will be greater annoyances with an anus placed in front. And it is obvious that in some conditions of daily life a lumbar opening may be very superior to one in front. Thus, at one time I watched for seven years a case of lumbar colotomy which I performed in a young married woman, aged 20.

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* Not needlessly large, for fear of troublesome prolapsus later.

† The following reasons have been given in explanation of this well-known fact—viz., the proneness of the cæcum to give way under the stress of distension, and even when at some distance from the obstruction. Dr. Coupland and Mr. Morris (*Brit. Med. Journ.*, 1878) attribute it to the *cul-de-sac* nature of this part of the intestine; its fixity and dependent position; its being the place where two currents meet—viz., from the ileum and, in case of regurgitation, from the colon; and the pressure to which it is subjected between the iliacus and the abdominal muscles. Mr. Lockwood (*St. Bart. Hosp. Reports*, vol. xix. p. 26) thinks that the explanation lies rather in the peculiarity of structure of the cæcum, as it contains a very large amount of lymphoid tissue, and as its walls are not strengthened equally with other parts of the large intestine by encircling bands.

The disadvantages of iliac colotomy next require attention.

1. There is the opening of the peritonæum. While I readily allow that antiseptic details, faithfully followed, have gone far to remove the old dread of the peritonæum, there is no doubt that a general adoption of iliac colotomy, with its necessary opening of the peritonæum, in all cases and by all operators, will add to the risk of the operation, especially when the bowel is distended and fæcal extravasation most difficult to guard against. The point is also alluded to, pp. 97, 107. The condition of our patients before colotomy, too often low and poor in repair, and the readiness with which a little peritonitis, ultimately fatal, may be excited, must not be forgotten here.

2. A much larger amount of prolapsus follows this than the lumbar operation. Of this there can be no doubt whatever. It must be so, on anatomical grounds, viz., the far greater mobility of the sigmoid colon, the greater laxity of the soft parts in the groin, as compared with those in the loin, where we have the lumbar fascia, psoas, and kidney. These points, together with the fact that in walking, standing, and sitting* the small intestines must necessarily tend to push upon and protrude an

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* "A pad and bandage which is satisfactorily adjusted with the patient standing will require readjustment with the patient sitting. . . . . I have been consulted by several subjects of iliac colotomy on this point, and found their grievance to be a real one" (Bryant, *Lancet*, 1881, vol. ii. p. 1215).

inguinal artificial anus, all explain why prolapsus after inguinal is so much more marked than after lumbar colotomy. This result, if the prolapsus be a large one, causes great discomfort to the patient, the projecting, moist, readily bleeding mass in the groin interfering much with cleanliness and locomotion. While the precautions given later will serve to diminish the amount of prolapsus, this will always give more trouble here than in the lumbar region: a tendency to large prolapsus there is quite exceptional; with iliac colotomy it is the rule. On the other hand, it is fair to remember that an artificial anus, as opposed to a fæcal fistula, is much more easily secured after an iliac colotomy.

3. Another objection to iliac colotomy, and one which I thought would be found a real one—that for disease high up in the rectum, or of the sigmoid flexure, an iliac opening would be placed too near the seat of mischief—does not seem to have been verified. Rectal cancer, for which iliac colotomy is usually performed, very rarely extends high enough up to give any trouble. If, on performing the iliac operation, the surgeon comes down on a growth in the sigmoid, he must resect it, or make an opening above it, or perform a lumbar colotomy.

Operation.

The parts having been duly cleansed, and shaved when needful, an incision 2 or 2½ inches long is made 1½ inch above and parallel with the outer part of Poupart's ligament and the anterior superior spine. There are two points here of the greatest importance from their bearing on the chief drawback of this operation, prolapsus. Mr. Cripps ("Complications arising in Inguinal Colotomy," *Brit. Med. Journ.*, Oct. 19, 1895) finds that by making his opening in the abdominal wall somewhat higher than in his earlier cases, there is much less tendency to protrusion. He now makes his "incision nearly as high as the level of the umbilicus, so that the wall of the lower part of the abdomen, where the pressure is greatest, is left intact." The other point to be insisted on is that, wherever the opening is made, it should be as small as possible. The freer the incision, the weaker the abdominal wall—already naturally weak here—and the more certain is a large prolapsus to follow. In an ordinary case of iliac colotomy for rectal cancer, the operator should endeavour to find the sigmoid with an opening admitting one finger to explore deeply, if need be, as far as the pelvic brim, and hook up the sigmoid. In more difficult cases the above small opening should be enlarged at either end with blunt-pointed scissors, cutting on the left index finger as a director. The layers of the abdominal wall having been divided, and all hæmorrhage arrested, the peritonæum is then raised, and slit up with scissors for about two-thirds of the wound already existing. The parietal peritonæum is now stitched to the cut skin on either side by a few points of chromic gut suture. This ensures peritonæal surfaces being in contact when the colon is brought up into the wound. This step has been criticised as unnecessary and as likely to increase the tendency to prolapsus. As the bowel will gradually form adhesions with the margin of the skin wound, the above precaution cannot be said to be absolutely needful; but as it is well, especially in the patients who come to us for colotomy, to assure speedy and firm union, I always make use of it. With regard to this step increasing the tendency to prolapsus, the precautions just given will obviate this. While the above suturing is going on, a small secured sponge should be placed in the wound. Either the sigmoid or the omentum or small intestine may be seen in the wound. If either of the two latter present (and the omentum may do so very persistently), they are returned, and the colon sought for with the finger. It is usually close at hand, and may be recognised by the scybala which it contains. In difficult cases the bowel will be found by searching in the iliac fossa, tracing up the rectum, or finding the descending colon over the kidney. It is well to remember that anterior colotomy is not always the easy operation, as regards finding the bowel, that it is represented to be. Mr. Cripps speaks (*loc. supra cit.*) of occasionally having had great difficulty in finding the bowel.

In one case, after a long search, he was unable to find the bowel; the nurse being directed to give an injection of water, the finger near the brim of the pelvis then felt a piece of intestine, which had before been overlooked, becoming distended, and the sigmoid, which was lying almost over in the right iliac region, was thus detected. In these cases of difficulty Mr. Cripps thinks that the colon will almost invariably be found nearer the middle line of the abdomen than where the operator has been searching.

In a case of Mr. Cooper's, reported by Dr. Pennington, of Chicago (*Journ. Amer. Med. Assoc.*, 1893, vol. ii. p. 773), the operator having failed to find the sigmoid, water was injected into the rectum, and was noticed to pass into the right iliac fossa. The opening in the left side being closed, an incision was made in the right inguinal region, where the gut—presumably the misplaced sigmoid—was readily found. The patient made a good recovery.

The bowel being found, a loop of it is drawn up into the wound. In the next step the operator should carefully follow Mr. Cripps (*Brit. Med. Journ.*, 1889, vol. i. 771). To avoid the prolapse which is certain to occur if loose folds of the sigmoid remain immediately above the opening, this surgeon gently draws out as much loose bowel as will readily come, passing it in again at the lower angle as it is drawn out from above. In this way, after an amount varying from one to several inches has been passed through the fingers, no more will come. As soon as the descending colon is found in this way to be nearly taut, a pair of dressing-forceps is pushed through the meso-sigmoid about a quarter of an inch from its attachment to the bowel, and a straight piece of catheter No. 10 or 12, or bougie, four inches long and quite clean, is caught in the forceps and drawn through. This is then supported outside the abdominal wall at either end by antiseptic gauze. If the meso-sigmoid is thick and laden with fat, a nick may be made over the forceps and rod, any vessel being, of course, avoided. Some green protective and iodoform gauze wrung out of carbolic-acid lotion should be then applied over the bowel, and firm pressure maintained.* The bowel may be opened by a transverse incision on the third or fifth day.† No anæsthetic need be given; if the patient is nervous, a 20 per cent. solution of cocaine may be applied. A few days later all the bowel that projects above the skin is cut away with scissors, Spencer Wells's forceps being applied to each bleeding point.

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* This is especially needed during the first few days. Mr. Cripps insists on the nurse sitting by the bedside to apply pressure if vomiting occurs.

† Vomiting and distension of the abdomen are other indications for opening the bowel early.

All sutures should be removed by the tenth day, or earlier if any redness is present.

Mr. H. Allingham (*Brit. Med. Journ.*, 1892, vol. i. p. 1013) believes that the above method, while preventing prolapse from the upper end, will not prevent its taking place from the lower when the mesentery is long. He accordingly, instead of pulling out the sigmoid until it is tight at its upper end only, pulls the bowel out until it is tight at the upper and lower ends alike, a step involving the withdrawing and heaping up outside the abdomen many inches of intestine when the mesentery is long. To keep the loop *in situ* a stitch is put through the skin on one side, then through the mesentery behind the bowel, back again through the mesentery, and then tied to the end of the suture which has passed through the skin. When this is tightened, the peritonæum of the meso-colon is kept pressed against the parietal peritonæum, and quickly adheres. The gut is also fixed to the edges of the wound in the ordinary way, and opened about the third day. After about a week Mr. Allingham cuts away all the projecting intestine, sometimes removing as much as a foot, a clamp being first applied close to the skin, while all above the clamp is cut away. The clamp is left on for twenty-four hours. As inguinal colotomy is chiefly performed for rectal cancer, this method, as I wrote in a former edition, appears to me to be needlessly severe. The kind of patients with whom the surgeon is now usually dealing must never be lost sight of. They are too often the subjects of a mortal disease, with no very long tenure of life before them, pulled down in strength and feeble in repair. Sir F. Treves also condemns the above method very strongly. "There is nothing to recommend this mutilation, and most surgeons will join with Mr. Bryant and others in their condemnation of this uncouth proceeding" (*Operative Surgery*, vol. ii. p. 375).

In his later papers Mr. Allingham admitted the severity of this proceeding for cases of cancer, and now reserves it for "cases of simple stricture where patients might live for years."

Mr. Cripps's far simpler and milder method described above—pulling out as much loose sigmoid as will easily come, returning the slack at the lower end of the wound as it is drawn out from the upper, and fixing in the wound a good loop of the part which is found to be tight—will be found amply sufficient. When the projecting loop has been pared down, as advised above, two openings will be seen separated by an efficient spur. Through the lower of these the rectum can be washed out, and the removal of any fæces lying above the disease facilitated. Gradually, usually in about a month, the patients will begin to acquire some control over their artificial opening, but it will not be till several months after the operation that they can be said to become comfortable in this respect, and acquire satisfactory control over, and management of, their artificial anus. And for the rest of their life discharge of blood and slime will occur from the anus with frequency, varying according to the rate of growth of the original disease. This must be met by astringent injections and suppositories. Diarrhœa must be treated by strict attention to diet, and by astringents; escape of offensive flatus or fæces from the artificial anus (which is more perceptible to the patient when the opening is made in front) may be met by the use of charcoal, a teaspoonful being given twice a day, or the following may be taken twice a day in a capsule or cachet, viz., betol, salol, salicylate of bismuth, of each gr. v. (Mr. C. Heath, *Brit. Med. Journ.*, vol. i. 1892, p. 1243).

Where obstruction is present, the bowels much distended, and the sigmoid requires immediate opening, anterior colotomy may still be employed, but additional care must be taken in handling the intestines and in preventing any escape of fæcal fluid or gas into the peritonæal cavity.

The following **methods** may be adopted:

Extra pains having been taken to suture the bowel accurately to the edges of the wound, the distended gut is incised, and the fæces as they flood the wound are washed away by a stream of warm water, which is kept constantly pouring over the wound for ten minutes until the distension is relieved. The wound is then most carefully scrutinised and washed, and the dressings applied (Cripps).

Mr. Barker (*Man. of Surg. Oper.*, p. 309) advises that the distended intestine should be opened with a fine trocar. On withdrawing the cannula the puncture is at once closed by mucous membrane. In one case Mr. Barker drew off the fluid through a temporary puncture for several days before a permanent opening was established. The patient made an excellent recovery.

The objection to this method is that where distension is urgent it will be difficult to give sufficient relief by a trocar which is of such small bore that a puncture by it will be safe.

A rubber drainage-tube of large diameter may be fixed in the bowel, as suggested by Greig Smith. This will be described under Enterostomy.

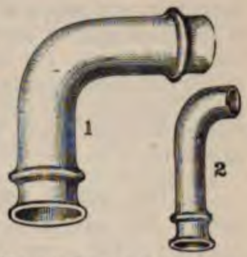
Mr. Mayo Robson has modified Mr. Barker's plan on two occasions with success by puncturing the bowel, already stitched to the side, with a large trocar and cannula, then fixing india-rubber tubing on to the cannula, so that the liquid fæces may be conveyed into an antiseptic solution by the bedside, thus preventing fouling of the peritonæum or wound.

To save the trouble of fixing the tubing on to the cannula when in the bowel, Mr. Robson has fixed the tubing on the cannula first, and then pushed the trocar through it. When the trocar is withdrawn, the slit in the tubing immediately closes, and prevents anything passing through it. This has led Mr. Robson to recommend a trocar with a small lateral limb attached, to allow a tube to be fixed on it to convey the fæces away from the wound. The end of the cannula within the bowel is rounded off so as to avoid a sharp edge; to the other end a short piece of tubing is attached which embraces the trocar, and is securely closed by a ligature as soon as the trocar is withdrawn. Nothing is said about any difficulty in retaining such a cannula in the bowel; it is merely stated that it may be held in position for the needful two or three days by strapping applied over an ordinary antiseptic dressing (*Brit. Med. Journ.*, vol. i. 1892, p. 65).

A Paul's tube may be tied in (Fig. 39). The objection which has been raised to the method, namely that sloughing and loosening of the tube take place too rapidly, may be met by making use of a purse-string suture to fix the tube, and by taking care not to tie the ligature tighter than is absolutely necessary. See also Enterostomy.

I would strongly impress on my younger readers the need of careful attention to the following points when dealing with chronic obstruction low down in the large intestine by inguinal colotomy. First, the sigmoid is difficult to find, owing to the tendency of the small intestine, much distended, to crowd out of the wound. It is very easy, during the necessary handling of such intestine, to make small tears in the peritonæal coat. In meeting the above difficulty the operator, if he cannot find the sigmoid quickly, should enlarge the wound and pack away the small intestine with flat sponges attached to forceps. The second point is the great care needed in suturing a distended sigmoid when it is brought to the lips of the wound, it being now very easy to perforate the mucous coat, and thus cause an escape of flatus or fæces before the peritonæal sac is shut off.

FIG. 39.



No. 1 is for the large, No. 2 for the small, intestine. The lower end is tied in, the upper receives the drainage-tube. (Paul.)

Madelung's Modification of Colotomy.—This has been largely used, both in the lumbar and inguinal operation, abroad. In this country it has not found favour. It consists in drawing out the bowel sufficiently, packing the wound with small sponges attached to silk, while the loop of intestine (which, if full, should be emptied as far as possible by squeezing its contents upwards) is packed around with tampons of iodoform gauze. The intestine being clamped, or held by the fingers of assistants, is next cut across. The clamp is then removed from the lower end, which is emptied, cleansed, and closed by careful suturing, viz., one continuous, and then others by Lembert's method, causing efficient inversion of the sutured extremity. This end is then dropped back into the peritonæal cavity. The upper end is now fixed in the wound, or is drained by tying a glass tube in it to which india-rubber is attached, by the method of Mr. Paul (Fig. 39) (*Brit. Med. Journ.*, vol. ii. 1891, p. 118).

The above method has never been much used in this country, for the following reasons:—

1. The great advantage which it claims, of preventing the passage of fæces into the lower part of the bowel, may be secured by much simpler means, viz., pulling out the bowel sufficiently to get an efficient spur, and cutting away the intestine afterwards.

2. It has inherent grave objections:—

(*a*) It has happened again and again that when the mesentery is long the sigmoid has, unknown to the operator, become twisted, and thus, when it is drawn up into the wound, the upper instead of the lower end may be closed and returned. In such a case fæcal extravasation through the sutures into the peritonæal cavity must occur. Mr. H. Allingham states (*Brit. Med. Journ.*, 1891, vol. ii. p. 337) that in seven of his inguinal colotomies the gut must have been thus "twisted," as fæces came away through the lower of the two openings. He states that he knows of a fatal termination from this cause in several cases in which Madelung's operation had been adopted. Mr. Cripps (*ibid.*, p. 447) has met with two cases in which what he believed to be the lower end of the bowel eventually proved to be the upper. Dr. Landon, of Göttingen (*Centr. f. Chir.*, Bd. xxx., 1891) has explained the above fact by a necropsy.

In two cases of inguinal colotomy in the Göttingen clinic, where the usual practice is to divide the gut and to stitch the two open ends in the wound, it was noticed that fæces always discharged from the lower and not from the upper opening, although at the operation the lower part of the intestine had been traced towards the bladder, and the upper in the reverse direction. In one of these cases, which terminated fatally, the necropsy showed that the sigmoid, which was very long and freely movable, passed upwards and outwards as far as the splenic flexure of the colon, and then curved downwards and towards the middle line, reaching the rectum after a long and tortuous course.

(*b*) The lower end of the bowel, whatever precautions are taken before the operation, will contain some fæces above the site of the cancer: if the lower end of the bowel be sutured, these fæces must cause irritation and increased discharge; if they be scybalous, and the bowel above the stricture thinned, as it often is, they may bring about fatal ulceration. (*c*) Closing the lower end prevents any attempt at washing out the bowel by syringing through from the colotomy opening to the anus or *vice versâ*, and so diminishing the constant tendency to sanious mucous discharge, which, if left to collect above the cancer, hastens its growth and promotes its sloughing. (*d*) It adds to the severity of an operation in patients who, from their present and in view of their future, need careful handling. This is true of inguinal colotomies when the bowel is empty. If it be distended, severing the bowel adds greatly to the difficulties of what is now a trying operation, and increases the risks of contamination of the peritonæum.

This modification of Madelung's is, I think, only justifiable when colotomy is performed previously to removal of part of the rectum: even under these circumstances I think it may be harmful, by preventing the washing out of the intervening bowel which may add so much to the comfort of the patient. Any surgeon about to divide the bowel should make certain of the lower end by asking an assistant to pass from below, if possible, a small œsophagus-bougie.

If the artificial anus contract unduly, it must be dilated with laminaria tents and the patient's finger. Mr. Cripps has introduced a spring dilator which is self-retaining, and which can be worn for four or five hours daily. That this complication is one to be watched for is plain from this passage in Mr. Cripps's experience (*Brit. Med. Journ.*, vol. ii. 1895, p. 966): "This is not an uncommon sequence, and, if allowed, will destroy the whole advantage of the operation. Too small an opening means a constant dribbling of fæcal matter, the motions never getting freely and completely away. These contractions do not occur where the original opening has been made of proper size, and where all the wound has healed by first intention, but occur where the angles of the wound have failed primarily to unite, and where the granulations gradually become converted into firm contractile tissue. If the angles have not united properly, the contraction will begin about the third week; and if at this time a little spring dilator be introduced and worn for a few hours daily for a month, the tendency to undue contraction will be obviated. If this precaution has been neglected, or be impracticable, the opening can readily be made the right size by passing the finger into the bowel, and then completely cutting through all the contractile tissue up to each angle, the depth of the cut exposing the wall of the bowel. The bowel is now freed a little on either side of the incision, and a curved needle and silk thread is passed through its edge, and through the tissues and skin at the apex of the reopened wound. This suture is tied, bringing the gut well up to the angle. A couple of additional sutures may be necessary at the sides."

Mr. Cripps considers that nothing in the way of a plug or truss answers so well as a dressing of lint smeared with some simple ointment, covered with a large flat pad of cotton-wool, the whole being kept in position by a wide flannel bandage, a perinæal strap being used if needful. If a plug is desired, one of the most comfortable is an india-rubber one, which can be introduced collapsed and then inflated by the patient. The chief drawback to this in hospital patients is that the india-rubber requires frequent renewal.

On the whole, I prefer a pad supported by a light spring truss to check any escape of flatus, &c. Its use should be begun early, to give support and check prolapsus.

Complications and Difficulties in Inguinal Colotomy.—Many of those given at p. 98 are common to the inguinal and lumbar operations. Some more specially belonging to the former operation will be given here.

1. Difficulty in finding the bowel. This has been fully entered into at p. 104. It is well to remember that the claim so strongly put forward, that the inguinal is an operation of no difficulty as compared with the lumbar, is not always correct. 2. Absence or shortness of mesentery. I will here quote Mr. Cripps (*Brit. Med. Journ.*, vol. ii. 1895, p. 966): "This is perhaps the most unfortunate and dangerous complication that can be met with, and to this cause, with one exception, I owe all my fatal cases. In the great majority of cases the mesentery of the sigmoid flexure is amply sufficient to allow of the bowel being well drawn up in the wound, and safely fixed without tension; but in 3 or 4 per cent. this is not so, for there is absolutely no mesentery, the bowel being bound firmly back against the posterior parietes. This is either due to congenital deficiency, or to malignant disease behind the colon fixing it firmly. The question to be considered is as to what should be done after the surgeon has opened the abdomen and met with one of these cases. I am confident, from my unfortunate experience, that any endeavour to invert the skin and forcibly drag it down to the bowel by the sutures is a fatal mistake. The sutures will certainly cut through, leaving an open peritonæal cavity. The surgeon has three choices: he may either abandon the operation altogether, he may close the abdominal wound on the left side and perform a colotomy on the right side, or he may endeavour by some modification of the usual operation to fix the bowel without dangerous tension. If he abandons the operation altogether I do not consider he is to be blamed, but most surgeons would prefer to close the wound and open the cæcum or ascending colon. Although the subsequent inconvenience of a right colotomy is far greater than the left, on account of the less solid nature of the fæces, nevertheless it fulfils the chief purpose for which colotomy was undertaken, namely, the

establishment of a permanent safety-valve against death from obstruction. If the colon is absolutely fixed and lying at some depth from the parietal peritonæum, this is the course I would advocate. If the bowel is not absolutely fixed, it may be possible by means of a Hagedorn's needle to suture the parietal peritonæum to the sides of the bowel, leaving sufficient space between the two layers for the opening. No attempt whatever must be made to draw the parietal peritonæum and the skin together, the skin and all the structures above the peritonæum being excluded from the sutures. By merely attaching the peritonæum in this way, the tension on the sutures is materially diminished. By opening the bowel opposite to the mesenteric attachment, and then fixing the cut edges to the parietal peritonæum, the tension on the sutures is further diminished. In any case, if the bowel has been fixed with the least tension, the patient must be carefully watched from day to day, and on the least sign of the bowel falling back, additional salmon-gut sutures should be at once passed through the whole thickness of the edges of the bowel and the abdominal walls." I would suggest another means of meeting this difficulty, which I adopted in the only case that I have met with in which the sigmoid was absolutely tied down in the iliac fossa, apparently from a congenital absence of the mesentery. The lower part of the incision being closed, its upper extremity was prolonged backwards into the lumbar region, where, at the junction of the descending and sigmoid colons, the bowel was sufficiently mobile to be brought up into the wound. This course will, I believe, always be found feasible. It is preferable to performing a right colotomy, as it saves two wounds, and rolling the patient over on to a recently made wound, while it removes an objection inseparable from a right-sided colotomy, that a more or less extensive tract of bowel is left below the opening, containing fæces which it is not easy to get rid of. 3. Prolapsus. The frequency of this after the operation has been explained at p. 102. It may be met (*a*) by making the wound as high up as possible (p. 103); (*b*) drawing down the intestine till the upper end is tight (Cripps), and then bringing it out through as small an opening as possible; (*c*) closing this opening round the bowel, and the bowel to the edges of the wound, as securely as possible, whether a rod (p. 104) has been used or no; (*d*) keeping the patient at rest until the parts have had full time to consolidate; (*e*) treating assiduously any such causes as constipation, coughing, straining in micturition, &c.; (*f*) trying the effect, as early as may be, of a light spring truss and pad. The two following complications may occur during vomiting or coughing. 4. Small intestine or omentum may escape between the piece of sigmoid which has been drawn out and the edges of the wound. This accident may be known by the urgent vomiting, pain, collapse, and soakage of serum into the dressings. These should of course be removed at once, the small intestine cleansed and returned, and the wound made safe by additional sutures. This accident is most likely to occur when a large wound has been made, an insufficient number of sutures used, and the nurse has not made efficient pressure with her hand over the dressings (p. 104). Where omentum protrudes—a much rarer complication—it may be left, as it will all shrivel away gradually, but additional sutures should be inserted at once. 5. A rarer accident, of which Mr. Cripps has published an instance (*Brit. Med. Journ.*, vol. ii.

1895, p. 967), is where the bowel tears away from its attachments and falls back into the peritonæal cavity. This happened on the seventh day during a violent fit of coughing.

"The released bowel discharged a considerable motion into the peritonæal cavity. Fortunately, I saw the case about an hour after the accident. The fæcal matter was thoroughly washed out from the abdomen, and the detached bowel restitched. The patient recovered." *

6. Strangulation of small intestine between the attached sigmoid and the parietes. An instance of this very rare accident will be found recorded by Mr. Cripps (*loc. supra cit.*, p. 967).

A patient on whom inguinal colotomy had been performed was about to leave the hospital when he was seized with symptoms of acute obstruction, the pain being referred to the colotomy opening. After vomiting three or four times the patient said he felt something slip in his inside; the vomiting ceased, and the pain suddenly left him. A few days after, feeling quite well, he was discharged from the hospital, and was re-admitted ten days afterwards in a dying condition. The necropsy showed that a loop of small intestine had slipped down into a canal, about an inch long, between the attached portion of the gut and the reflection of the parietal peritonæum, near the anterior superior spine. From this canal the intestine must have released itself at the first attack. Mr. Cripps adds that prompt abdominal section would have saved this patient.

Causes of Death after Anterior Colotomy.—Many of these will be the same as those given in the account of the lumbar operation (p. 100), and others, more peculiar to the anterior operation, have been so fully given in the pages just preceding that there is no need to repeat them here.

RIGHT INGUINAL COLOTOMY.
MAKING AN ARTIFICIAL ANUS IN THE CÆCUM.

This operation is but rarely made use of. One objection to it is that, owing to the proximity of the small intestines, the intestinal contents are likely to be more liquid, and thus to cause more trouble afterwards. It may be resorted to under such conditions as the following:

1. When, in chronic obstruction of the large intestine, the site of the mischief is uncertain and the cæcum is much distended. Here, owing to the tendency of the cæcum to slough from over-distension, a surgeon would be quite justified in cutting down upon the cæcum instead of resorting to right lumbar colotomy, if he felt sure of being able to prevent contamination of the peritonæal cavity from the escaping fæces.

2. When, during the performance of a right lumbar colotomy, finding the colon is impossible.

In the above instances the cæcum would be reached by an incision made over it. And, personally, when the surgeon has been exploring the site of an obstruction through the linea alba and determines to open the cæcum, I think it would be wise to do this through a second incision in the right iliac region, as I consider it risky to anchor intestine in the middle line.

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* Mr. C. Heath's remarks on this or a similar case (*Brit. Med. Journ.*, vol. i. 1892, p. 1243) are worth the attention of anyone inclined to think lightly of such an accident because the patient recovered. "Of course we hear of one case that did recover, but we do not hear of the ninety-and-nine cases which did not." The remarks which follow on the value of statistics are too bitter for me to insert them here, but they contain a very large germ of truth.

Sir F. Treves (*Lancet*, vol. ii. 1887, p. 853) published a very successful case, in which exploration in the middle line detected a stricture at the termination of the descending colon. As the cæcum was enormously distended, its peritonæal coat having given way at several spots, he brought the cæcum into the wound in the linea alba, bringing all the most damaged part out of the wound, which was united round it. A puncture of the cæcum through one of the rents allowed an immense amount of gas to escape. Fortunately no fæces were seen. The hole in the bowel was clamped, and the wound dressed with iodoform. When the bowel was opened on the fifth day a large quantity of fæcal matter escaped. Six months later the patient was in excellent health.

On the other hand, the case of Mr. Cripps, which I quoted at p. 111, shows how very small a space between anchored bowel and the parietes may be sufficient to bring about a fatal strangulation.

Operation.

This differs so slightly from a left-sided iliac colotomy that very little more need be said.

The incision should be about three inches long over the distended intestine, or parallel with the outer part of Poupart's ligament and the iliac crest. There may be no meso-cæcum; in such a case the surgeon may experience considerable difficulty in getting the cæcum satisfactorily into the wound.

MAKING AN ARTIFICIAL ANUS IN THE TRANSVERSE COLON.

This is the most rarely performed of all the colotomies. Mr. H. Allingham gives three cases in his book on Colotomy, p. 170—one of his own, and two performed at St. George's Hospital.

In one, chronic obstruction was present, and a median incision showed a growth in the descending colon. The lower part of the exploring incision having been closed, in the upper two inches the parietal peritonæum was stitched to the skin; the transverse colon was brought out here and stitched in the usual way. The bowel was opened the next day. In another case, opening the transverse colon was preferred to lumbar colotomy, on account of the difficulty of making a satisfactory spur in the latter position.

CHAPTER IV.

OPERATIONS ON THE KIDNEY AND URETER.

NEPHROTOMY—NEPHRO-LITHOTOMY—NEPHRECTOMY—NEPHRORRAPHY—OPERATIONS ON THE URETER.

NEPHROTOMY.

Indications.—The following are the principal conditions which demand this operation:—

i. **Pyonephrosis and Abscess of the Kidney.**—When due to tuberculous disease, and the tumour is large, or the patient is not in a condition to stand primary nephrectomy, nephrotomy should be performed as a preliminary measure; when, however, there is evidence of disease of the opposite kidney or of other viscera, nephrotomy alone is available. The results, however, when a secondary nephrectomy cannot be performed are, as might be expected, extremely unsatisfactory. Otto Ramsay, of Baltimore (*Annals of Surgery*, vol. ii. 1900, p. 461 *et seq.*), gives the results of fifty-five cases. Of these, four at the most, and probably two only, can be considered as cured.

When the abscess is due to calculi, these will be removed and the cavity drained, except in special cases where nephrectomy is indicated (*vide infra*, p. 130).

In a few rare instances pyonephrosis may be due to a stricture of the ureter. An example of this condition is referred to below under the Surgery of the Ureter (*vide* p. 170).

ii. **Hydronephrosis.**—If the kidney has been entirely destroyed, and the size of the tumour prevents removal, incision and drainage should be employed either as a method of cure or as a preliminary to a secondary nephrectomy.

iii. As an exploratory operation for diagnostic purposes for certain obscure renal symptoms. Some of the conditions that have been found are mentioned below under Nephro-lithotomy (*vide* p. 118); in others a calculus will be found. In others again, particularly where the only symptom is hæmaturia, the exploration may have a negative result.

Hurry Fenwick (*Brit. Med. Journ.*, vol. i. 1900, p. 248), however, records two striking cases of operation for unilateral painless renal hæmaturia.

In the first case, a young lady, aged 18, had suffered from attacks of hæmaturia for five years, causing marked anæmia. With the cystoscope the blood was seen to come from the left ureter. At the operation the left kidney was brought out on to the loin, the pelvis incised and illuminated with electric light. It was then seen that one of the renal papillæ was of a bright red colour, and appeared to be villous on the surface. The papilla and half the pyramid were removed with a Volkmann's spoon. No hæmaturia has occurred since the operation.

In the second case there had been alarming hæmaturia for a fortnight, producing profound anæmia. The blood was seen to come from the left ureter. The operation was similar to that performed in the first case, as was also the condition found. This case was likewise completely cured.

iv. **Anuria.**—This will be dealt with later (*vide* p. 137).

Operation.—As this is identical with the first stages of a nephro-lithotomy the reader is referred to the description of that operation (*vide* p. 123).

NEPHRO-LITHOTOMY.

The following are the chief **symptoms and conditions justifying nephro-lithotomy**:—

1. *Continued Hæmaturia, or Passage of Blood and Pus.*—I may at once be criticised for putting this first; and, indeed, it is somewhat difficult to decide which symptom of renal calculus is clinically the most important.[*] On the whole, I am inclined to agree with an old friend, G. A. Wright, of Manchester (*Med. Chron.*, March 1887, p. 463), who considers "renal hæmaturia as the only single symptom of anything like cardinal importance," if without evidence of nephritis.

A few words as to the character of the hæmaturia of renal calculus and the fallacies which must be borne in mind. It is a hæmaturia of long standing, often repeated, frequently increased by exercise or jolting, rarely profuse, and never producing anæmia, as in growth of the kidney. Always intimately mixed with the urine, the tint varies from a bright or deep red (which I think are rare) to a smoky or porter-like colour.

Fallacies: (*a*) Hæmaturia may be absent from first to last. This, an undoubted fact, is one very difficult of explanation. It was the case with the smaller calculus (Fig. 40). And this is the more extraordinary as the stone is covered with minute crystalline spicules, a condition which would have appeared certain to lead to oozing from the inflamed mucous membrane of the pelvis in which the stone lay. The only explanation that I can give is that at the operation I found the abdominal muscles extremely rigid; even when the patient was fully anæsthetised, they gave the impression to the scalpel of cutting through tissues frozen by ether. Now, if it is fair to suppose that on the other side of the kidney the quadratus and psoas were as firmly contracted, the kidney and the stone in its pelvis may have been so firmly held that no irritation by the calculus could take place, and thus no hæmaturia. (*b*) Another fallacy is that the hæmaturia of calculus may be only temporary, present for a while and then ceasing altogether. This occurs, though rarely, when a small renal calculus becomes encysted. (c) The value of hæmaturia, though only occasional, is shown by a case of Dr. Owen Rees', to which Mr. Morris has drawn attention.

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[*] Being convinced of the frequency of errors of diagnosis in renal calculus, I have dealt with these fully. I may also refer my readers to my paper, *Brit. Med. Journ.*, 1890, vol. i. p. 117.

It was that of a young lady with lumbar pains and frequent micturition, which were both put down to the hysteria that was markedly present. After a while, hæmaturia was found to be present on several occasions, and eventually, after death, a mulberry calculus was found in one kidney.

Other fallacies are presented by the host of kidney conditions which may give rise to hæmaturia—namely, (1) the passage of uric acid crystals; (2) tubercular kidney; (3) granular kidney; (4) growths; (5) increased intra-renal pressure, &c. To these I shall refer later.

2. *Pain and Tenderness, Lumbar and elsewhere.*—(*a*) FIXED LUMBAR PAIN.—Characters: Generally dull, gnawing, pricking, or aching, increased usually by exercise, twisting from side to side, or flexing the body.* Sometimes it is relieved by pressure of the hand, leading to thickening and vascularity of the parts when they are incised at the operation. (*b*) RADIATING PAIN, for example, in the testis,† region of the small sciatic nerve, calf, foot, or in the intestine simulating colic. It is easy to see how readily the pain of a renal calculus, if limited to distant parts, and if occurring without hæmaturia, may mislead. Another point with regard to the pain of renal calculus is the frequency of nocturnal exacerbations. The explanation of this is doubtful, whether, as Mr. Morris has suggested, from the passage of flatus in the colon, at this time over a stone in the pelvis, or, as I venture to think more probable, as accounting for stone whether in the pelvis or in one of the calyces, to the concentration of the urine, and consequent deposit of crystals, which takes place at night, is unsettled. The fact, however, is undoubted.

In the case of a patient, aged 58, who had suffered from symptoms of renal calculus for thirty years, and from whose left kidney I removed the huge calculus (Fig. 40), the pain at night was often so severe as to drive him from his bed into his garden or the streets of the town in which he lived.

(*c*) RENAL COLIC.—Very acute in character, radiating from the loin, usually downwards, and accompanied often by rigors, nausea, vomiting, and profuse perspiration. The attacks are usually recurrent, and vary greatly in severity.

On the other hand, pain is, much more rarely, absent.

With regard to *tenderness*, Mr. Jordan Lloyd (*Pract.*, vol. xxxix. p. 178), in a paper to which I shall have again to refer, writes thus: "I attach great importance to the evidence to be obtained by immediate percussion over the suspected organ, a method of investigation which has not received that amount of attention to which it is entitled. It is best practised from the loin, just beneath the space between the tips of the last two ribs, and should be made in a direction upwards, forwards, and slightly inwards. It is best for the patient to stand upright before you. The blow should be sharp and decisive, and of force sufficient to affect a structure situated several inches below the surface. It may also be practised from the front, at a point midway between the umbilicus and ninth rib. When a calculus is present, the patient will complain of sharp, stabbing pain at the moment of percussion. Other conditions doubtless give rise to percussion pain, but not of the characteristic stabbing of calculus."

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* As in going upstairs; probably from the pressure on the kidney by the contracting psoas. But the relation of the pain to movement, and the kind of movement which most induces pain, vary greatly. Thus Mr. Butlin's patient is said to have suffered greatest pain when driving, least when riding. Prolonged walking seems the most frequent cause.

† In a case of Mr. Butlin's (*Clin. Soc. Trans.*, vol. xv. p. 113) the patient sought relief from severe neuralgia of the right testis, which was generally retracted and extremely tender. Later on it was noticed that these neuralgic attacks were associated with some lumbar pain and tenderness. Complete recovery followed after the removal of a small, prickly, calcium-oxalate calculus from the pelvis of the right kidney.

I have tried the percussion test of Mr. Lloyd in many of the cases which have come under my hands for nephro-lithotomy (table, p. 138) since his paper was published. In three the tenderness was increased, but in one only was there any "characteristic stabbing." In this, where a small and very spiculated oxalate of lime calculus occupied the top of the left ureter, the patient at once said, "You stab me there." This patient, No. 5 in the table, was thin and spare. Tenderness more or less marked will, however, be usually elicited by making firm pressure upon the kidney between the two hands, one placed in front and one behind the kidney.

3. *Points in the Previous History.*—Space will only allow of my noticing a few of those given above, namely, lithiasis and oxaluria, history of previous passage of a stone, history of previous colic.

The history of long-standing lithiasis and oxaluria is of obvious importance, from the fact that the habitual passage of crystals or gravel and the formation of a calculus lie not far apart. But there is another point which has not, I think, received sufficient attention, and that is, that in patients who have habitually, for many years, passed uric acid and oxalate of lime, there is a most serious risk that the minute anatomy of their kidneys will have become seriously damaged by the constant presence of the above crystals. We should all be agreed as to the damaging effect of multiple calculi on the secreting tissue of the kidney. I would suggest that in the future the results on the kidney of the daily passage of crystals of uric acid and lime oxalate must receive sufficient attention before patients at all advanced in life are submitted to nephro-lithotomy. Furthermore, it is obvious that long-continued lithiasis and oxaluria will very likely have led to the formation of bilateral stones.

Under the heading of Renal Colic, I would point out that the vomiting and nausea which are thought to be characteristic of the agony of a descending calculus may also be caused by a stone which is distending the renal pelvis, but has not yet begun to make its way down.

4. *Frequency of Micturition.*—The co-existence of irritability of the bladder with renal calculus is well known, and may be explained either by nerve disturbance, or by the blood and pus, or the over-acid urine which often accompanies stone in the kidney.

A point with regard to bladder irritability is that it may be of value in making that most difficult diagnosis between a calculous and a tubercular kidney. Thus, if a patient with hæmaturia, lumbar pain, &c., has irritability of the bladder which is not relieved by rest in bed, but which continues by night as well as by day, it is probable that this is due not to trouble in the kidney alone, but to co-existing ulceration of the bladder, and this will probably be confirmed by examination of the prostate and vesiculæ seminales in the male, and by digital exploration of the bladder in the female.

5. *Skiagraphic Evidence.*—So many obscure cases of renal and ureteral calculi have now been made clear by means of radiography that, wherever the means are at hand, cases that are at all doubtful should be submitted to this test. If a distinct shadow is seen in the skiagram of the affected side, it may be taken to be indicative of the presence of a calculus. On the other hand, the absence of a shadow cannot be said, in the present state of our knowledge, to prove the absence of a calculus.

6. *Failure of Previous Treatment to give Relief.*—I can only touch on one point here—*i.e.*, the question of the advisability of trying to exert any solvent action on a calculus in the kidney. Whilst, for myself, I attach the greatest importance to the use of large quantities of water, it is rather because this, by washing out the kidneys, removes collections of crystals, and gets the patient into a better state for operation, than because I believe in its possessing any actively solvent action upon the calculus. I do not forget that Sir W. Roberts has proved by experiments on calculi, both those without the body and those in the bladder, that urine rendered alkaline by fixed alkali has a distinctly solvent action.

Dr. Ralfe has reported (*Path. Soc. Trans.*, vol. xxxiii. p. 206) a case of a patient, aged 37, who, after suffering from uric acid gravel for some years, had a violent attack of renal colic, with profuse hæmaturia, no calculus or gravel being discharged. Alkaline treatment was at once resorted to, and for a time afforded relief, but the patient could not be persuaded to continue it systematically. He was then ordered to drink copiously of soft water—filtered rain-water. Two years later he began to pass grit and scales of calculous matter with his urine; and shortly afterwards, after a severe attack of colic, he passed the shell of what had evidently been a solid calculus.*

But it must be remembered that, as my late colleague Dr. Hilton Fagge pointed out (*Medicine*, vol. ii. pp. 373, 383), such solvent treatment is only worth trying in the case of uric acid calculi. He at the same time showed that the greater relative frequency of lime oxalate calculi over those of uric acid, especially in patients after early adult life, is much more marked than is generally believed. Moreover, as Morris (*Hunterian Lectures*, 1898) points out, it cannot be too strongly urged that, in the presence of definite symptoms of calculus, any prolonged course of palliative treatment is to be deprecated, for during this time the stone may be steadily but slowly destroying the kidney, and so valuable time will be lost.

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* Dr. Ralfe (*Diseases of the Kidneys*, p. 523) points out that the solvent action of distilled water is due to several influences. In the first place, by causing a low specific gravity of the urine, it induces disintegration, since Rainey has shown, experimentally, that bodies placed in solutions of different density to those in which they were formed undergo molecular disintegration. Again, chemical analysis has shown that those calculi that undergo spontaneous disintegration are always poor in inorganic constituents: the use of soft water diminishes the supply of these, even if it does not actually act as a solvent on those forming the outer crust of the calculus, and so increases the tendency to disintegration. Lastly, soft water probably diminishes the catarrh of the urinary passages, and by diminishing the swelling of the mucous membrane allows a small stone to pass which was before obstructed.

7. *Calculous Anuria.*—Exploration of the kidney in this extreme condition is urgently called for, although in a few cases recovery has taken place without operation. Morris (*loc. supra cit.*) gives two collections of cases, those operated on and those not operated on. Of forty-eight cases not operated on, ten, or 20·8 per cent., recovered; of forty-nine cases operated on, twenty-five, or 51 per cent., recovered. These figures speak for themselves.

The most important and difficult point to decide is the question as to which kidney should be explored. If it can be determined which kidney has become the more recently affected, this should be chosen for operation, because this kidney will be the one that is least destroyed by disease. Apart from history, abdominal pain, rigidity, and tenderness may help to clear up this point. This subject is again referred to later, p. 137.

Conditions which may simulate Renal Calculus.—Before deciding to operate on a given case, it must be borne in mind, in addition to what has been already said, that many other diseases may give rise to the same symptoms as renal calculus.

So closely do some of these conditions simulate renal calculus that a correct diagnosis can only be arrived at by means of an exploratory operation. Morris (*loc. supra cit.*) gives a list of no less than forty-four cases occurring in his own practice in which the kidney was explored for stone, and no stone found. In a few of the cases a calculus was passed soon afterwards, so may have been lodged in the ureter at the time of the operation. In the majority of the cases, however, some other morbid condition of the kidney or ureter was found and remedied. So that, although no stone was found as the result of these operations, no harm was done in any (for none were fatal), and good was done in the majority. Morris says: "It is certain that the diagnosis of calculus, though incorrect, was advantageous to the patients, for the very reason that it led to the exploration, and in this way to the discovery of the true cause of the disease."

These conditions simulating calculus must now be severally considered. They may be usefully divided into two groups—affections of the kidney and ureter, and diseases of other organs.

A. **Affections of the kidney and ureter which simulate renal calculus.**

1. *Lithiasis.*—I have already alluded to this condition as one which simulates renal calculus by the hæmaturia which crystals of uric acid may cause. Lumbar and testicular pains are also points which mere lithiasis shares with renal calculus. The diagnosis will not be difficult by watching the result of treatment, which only gives relief in the one, but clears up the other. Exercise, again, is a test.

2. *Tubercular Kidney.*—Lumbar pain and tenderness, frequent micturition, hæmaturia, are all common to tubercular kidney and renal calculus. The chief aids in the diagnosis appear to me to be: (*a*) the pyuria; (*b*) careful examination of the urine; (*c*) early pyrexia; (*d*) early exploration of the kidney.

(*a*) Pyuria.—This is usually present early in the case with a proportionate amount of albumen, without much hæmaturia, the blood often occurring only as a thin layer over the pus at the bottom of the urine-glass, or as small, thready clots. With all the pus the urine is strongly acid at first, then more feebly so, but often remains slightly acid to the last. (*b*) Careful examinations of the urine.—The sediment contains caseous matter, and sometimes *débris* of connective tissue can be made out, a point of much importance. Finally, there is the bacillus tuberculosis. While I am well aware of the frequent want of success in demonstrating the presence of the bacillus in urine as in bone, I may add that it was found in six out of the thirteen cases in which I have been asked to explore tubercular kidneys.[*] (*c*) Pyrexia.—I do not here speak of the hectic which accompanies the advanced stage, but of the pyrexia which may be an important factor in the diagnosis much earlier in the case. Often intermittent at first, and liable to be overlooked in the anorexia, nausea, and debility which accompany it, later on, and too late, it becomes only too evident and confirmed. (*d*) Early exploration of the kidney.—Morris mentions three cases in which tuberculous foci were found in the kidney and excised. In one case three separate wedges of kidney substance were removed, and the resulting gaps in the kidney closed by sutures. This matter is referred to later, p. 158.

3. *Hydronephrosis* due to stricture of the ureter, or a valvular obstruction at the commencement of the ureter. Several remarkable cases of this nature have been described, notably those of Morris and Fenger. These will be referred to later, p. 169. Mr. Bruce Clarke has also published (*Lancet*, vol. ii. 1891, p. 984) two cases of this kind in which the cause was not found. The first was perhaps an early stage of hydronephrosis, and the pain a very prominent feature, dull and aching, with severer attacks; but, as it was found at the operation that "the kidney pelvis was very slightly dilated," the case is not decisive. The second is more convincing. The kidney here was dilated and a mere shell, no cause being found. There was a definite history of several attacks of renal colic, and Mr. Bruce Clarke thought that these had probably been caused by kinking of the ureter.

4. *Slight Pyelitis, not Tubercular.*—This condition may, by hæmaturia, pus in the urine, lumbar and testicular pain, simulate renal calculus closely. It may follow a gonorrhœa, perhaps a previous stone, or occur in women after pregnancy; perhaps, as Dr. M. Duncan thinks, from some parametritis extending up the psoas to the peri-renal fat and kidney.

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[*] I may point out here that bacteriology will help the surgeon in difficult cases. My colleague, Dr. Washbourne, has thus cleared up two obscure cases for me. One, a delicate woman of 32, with a tubercular history, was sent to me by Dr. Forty, of Wotton, in Gloucestershire, with obstinate cystitis and irritable bladder. The endoscope and digital exploration showed swollen and hyper-vascular mucous membrane, but detected no ulceration. Wiping over the mucous membrane with a solution of silver nitrate (gr. xl.—℥j) was followed by very great relief lasting over two months on two occasions. At my request Dr. Washbourne injected some of the pus containing urine (in which no bacilli could be found) under the skin of a guinea-pig. No result apparently followed, but, when the animal had been killed, *one* of the nearest chain of glands was enlarged and caseating. A few undoubted bacilli tuberculosis were found in it. This and the other case will be found in the *Guy's Hosp. Rep.*, 1890.

5. *Movable Kidney*, especially if associated with neuralgia, pyelitis, or if recurring with some of the reflex causes of nephralgia to be mentioned below. The following case under Mr. Watson Cheyne (*Brit. Med. Journ.*, vol. i. 1899, p. 17), in which there was severe hæmaturia, caused probably by congestion due to kinking of the renal vessels, is worthy of note in this connection.

A woman, aged 40, had a fall, hurting her back, in 1885. This caused great pain and hæmaturia, the urine being bright red in colour. This continued for five weeks, during which time the patient was confined to bed, and then ceased. There was no further hæmaturia for ten years, although pain was present during most of the time. Severe hæmaturia then occurred again, and again stopped after a time. In June 1897, severe hæmaturia and pain came on again, and continued till November, when the operation was performed. No stone was present, but the kidney was found to be freely movable. The kidney was fixed, with the result that hæmaturia ceased immediately and did not recur.

6. *Ureteritis.*—The following is a very striking instance of this rare disease, described by Israel (*Berl. Klin. Woch.*, xxvii., 1893):

A young man, aged 28, had for eight years suffered from a urinary affection which began with frequency of micturition. Soon acute attacks of pain in the bladder and left renal colic of extraordinary severity began. The clinical examination in corroboration of the patient's account left no doubt as to the presence of renal calculus: there were frequently blood and mucus, but no tubercle bacilli, present in the urine; there was also tenderness in the left flank, and pain was caused by pressure on the ureter through its abdominal course. The kidney was explored, and found to be small and soft, but no calculus was present. The wound healed rapidly, but the symptoms continued as bad as ever.

Two months and a week later the kidney was again explored, and then it was discovered that the ureter throughout its length was extraordinarily hard, of nearly three times its normal diameter, and presented at intervals enlargements of quite cartilaginous consistence. The ureter was permeable from kidney to bladder, but at three points slight obstructions were present, due to folds of thickened mucous membrane, the result of ureteritis. Nephrectomy was performed, and resulted in a complete cure.

7. *Aching Kidney.*—Under this title Dr. M. Duncan has described a condition, especially common in women, which may simulate renal calculus. Its chief features are a heavy, wearying pain, deep in the side, usually accompanied by tenderness, often great; the pain may run in the course of the great sciatic or anterior crural, and is frequently accompanied by irritability of the bladder, and by pain in the course of the ureter. The disease is liable to be aggravated by exercise. The chief points in the diagnosis of this condition are, Dr. Duncan points out, the absence of blood and pus, the fact that the "aching" often occurs only at the menstrual periods and is always worse then, from the intimate connection between the kidneys and the generative organs, not only developmental but pathological. A definite nephralgia is also caused sometimes by malaria, as pointed out by Morris, and may be relieved by the administration of quinine.

8. *Interstitial Shrinking Nephritis.*—This condition may simulate renal calculus both by hæmaturia and pain.

Dr. S. West (*Lancet*, 1885, vol. ii. p. 104) drew attention to the hæmaturia which may accompany granular kidney, and published three cases, aged 21, 19, and 24; in the first the hæmorrhage was profuse. Mr. Bowlby (*Clin. Soc. Trans.*, vol. xx. p. 14) also published three cases, aged 73, 49, and 64; two of these died, and the kidneys were found markedly granular. He points out the following as distinguishing this condition from renal calculus: The specific gravity of the urine, after the blood has cleared up, only 1008 to 1015; tortuous arteries, cardiac hypertrophy, and high arterial tension; blurred, ill-defined discs, some retinitis and effusion amongst the blood-vessels. The paper concludes with the following warning: "Unless it be recognised that blood may emanate from a kidney which is simply granular, operations may be undertaken for the removal of renal calculus."

With regard to renal pain in granular kidney, this is of two kinds. There is the dull aching generally found, if the case be watched, to be felt across both loins, as well as in one side. Occasionally, though this is rarer, the pain occurs in violent paroxysms, simulating renal colic. This was so in the case to which I have alluded, and to a more marked degree in one brought by Mr. Mansell Moullin before the Clinical Society (*Trans.*, vol. xxv. p. 60). If now, in addition to the hæmaturia and paroxysmal pain, there be nausea, passage of uric acid, and frequent micturition, the mistaken diagnosis of calculus may easily be made. Where granular kidney is possible, such a case should be carefully watched, and if the specific gravity of the urine never rises above 1015, the question of operation must be entertained with the greatest caution, and the very great risks most clearly put before the patient.

Other conditions mentioned by Morris as having been found in some of the above-mentioned forty-four cases are—small abscesses, or suppurating cysts, solid renal or peri-renal tumours, tense cysts, blood extravasated either under the capsule or within the substance of the kidney, dense adhesions.

B. **Diseases of other organs which may simulate renal calculus.**

1. *Gastric and Duodenal Ulcer.*—Morris has seen a case of gastric ulcer which simulated renal calculus, and Ralfe (*Brit. Med. Journ.*, 1888, vol. i. p. 183) gives one which he thinks was due to duodenal ulcer.

Thus, a patient had many symptoms of renal colic, and three attacks of paroxysmal pain accompanied by vomiting, great tenderness in the right renal region, urine loaded with uric acid, but no pus or blood. The patient, who was losing flesh, recovered with treatment directed to duodenal ulcer.

2. *Intestinal Adhesions.*—A case is given by Dr. Tirard (*Lancet*, vol. i. 1892, p. 16). Though (as the kidney was only punctured) the presence of a calculus cannot be excluded in this case, it is very possible that the explanation given below may meet other nephralgias. A schoolboy, aged 12, gave a history of hæmaturia with severe pain, after another boy had jumped suddenly and roughly on his back. There was only this one attack of hæmaturia, but from this time occurred frequent attacks of severe pain, which seemed to return with any sudden jolting movements, a railway journey or a ride in a hansom often proving sufficient exciting cause. It was also noticed that the pain was worse with constipation or diarrhœa. Although no certainty was felt about the presence of a renal calculus, it was generally thought that the symptoms might be due to this. At the operation no stone could be found, though the pelvis and the substance of the kidney were carefully explored with a needle. A firm cicatrix was, however, discovered, circling the capsule of the kidney and the descending colon, and this was so tough and so extensive that it was thought expedient not to divide it.

The lad recovered, and is now able to keep fairly free from pain so long as he attends closely to the action of the bowels.

3. *Gall Stones retained in the Gall Bladder* may be taken for right renal calculus. Dr. Murchison pointed out long ago that they not infrequently coexist. My old friend, G. A. Wright, of Manchester, has recorded (*Lancet*, 1885, vol. i. p. 563) a case in which the right kidney was explored for a calculus believed to be in the ureter.

On exploring this tube a hard spot was felt near the brim of the pelvis, and taken for a stone in the ureter. A calculus the size of a pigeon's egg was removed and found to be a gall-stone. Acute peritonitis carried off the patient, and a stone was found to exist in the pelvis of the right kidney, with its apex in the ureter.

While on this subject of nephralgias due to conditions of viscera near the kidney, I may refer to some remarks of Mr. Godlee (*Pract.*, vol. xxxix. p. 246), in which he insists that repeated attacks of intestinal colic, especially if accompanied by nausea, may be the only symptoms of the presence of either a renal or biliary calculus, and that this fact should lead the practitioner to investigate the state of the kidney and urine, bearing in mind the possibility of the symptoms being due to renal or biliary calculi.

4. *Spinal Disease.*—The great difficulty which may arise in diagnosing between certain cases of spinal caries and renal calculus is not yet sufficiently recognised. A writer already quoted from (G. A. Wright, *Med. Chron.*, No. vi. p. 642) thus alludes to this matter:

"Where a local patch of caries of a vertebral body exists, and especially where deep suppuration occurs and presses upon the kidney, as in a case of my own and one or two others which I have seen, nearly all the symptoms of a calculus have been present. In my own case, without any deformity or tenderness of the spine, there was unilateral rigidity, testicular pain, intermission of symptoms, increased frequency of micturition, nausea during attacks, and oxaluria, with local pain and tenderness. Subsequently an abscess developed, and on exploration a small patch of caries was found, and the kidney was felt exposed in the anterior wall of the abscess cavity. Probably, as in floating kidney, obstruction of the vessels and ureter may arise and cause symptoms, so that pressure of the spinal abscess may disturb the kidney, and quite possibly give rise to hæmaturia."

In addition to the above, Morris alludes to having known cases of each of the following conditions give rise to symptoms simulating renal calculus:—malignant and tuberculous growths in the intestines, aortic, or cœliac aneurysm stretching the ureter or renal vessels, vesical calculus, abscess and calculus in the prostate, growths in the bladder, ovaritis, and tuberculous disease of the Fallopian tube. Finally, I must mention the following exceptional case of *malignant disease involving the last dorsal nerve*, that came under my care seventeen years ago:

The patient, aged 44, came with hæmaturia, wearing pain, tenderness in the right loin and thigh, and oxaluria. His childhood had been passed in Norfolk, and as a lad he had been cut by Mr. Birkett for stone in the bladder. I sounded him twice, and finding no stone, I swept the sound in contact with the bladder in different directions, in the hope of detaching fragments of growth if one were present. No relief being given by drugs, I explored the right kidney, and could find nothing abnormal. Four days after the operation, when all seemed to be doing well, the patient died very suddenly. At the necropsy we found (*a*) a primary carcinomatous growth of the bladder of a somewhat unusual kind; it involved the apex as a flocculent, superficially ulcerated area; (*b*) a ring of secondary deposit surrounding the *right* last dorsal nerve, just at its exit from the spine; (*c*) a mass of enlarged glands around the inferior vena cava, and at one spot sprouting into it; (*d*) the *left* kidney contained a large branching calculus.

Operation.—The patient being in much the same position as that for lumbar colotomy, on the sound side, with a firm pillow under the opposite flank, the surgeon defines carefully the lower border and length of the last rib. That this is not an unimportant detail in renal operations is proved by the following:

Prof. Dumreicher,* of Vienna, accidentally opened the pleural cavity during an attempt to remove a pyonephrotic, calculous kidney. At the necropsy it was found that the last rib was rudimentary, that the pleura projected a good deal below the lower edge of the eleventh rib, and that thus, when the incision was carried upwards, the accident had become unavoidable. Dr. Lange, of New York, has called attention to the investigations of Dr. Holl,† of Vienna, on the frequency of rudimentary development of the last rib, and the importance, therefore, of counting the ribs before intended operations on the kidney. Dr. Lange ‡ himself shows that in some cases, which are, however, exceptional, even normal development of the twelfth rib may demand extreme caution, as the pleura may project considerably below it. §

The surgeon, having defined the length and position of the lowest rib, makes an oblique incision, at least 4 inches long, ½ inch below it, and beginning about 2½ inches from the spine. The skin and fasciæ being divided, the muscles—viz., anterior fibres of the latissimus dorsi, the external and internal oblique—are cut through, either on a director, or simply by light sweeps of the knife. As soon as the yellowish-white lumbar fascia is reached, any bleeding vessels, which have been temporarily secured by Spencer Wells's forceps, are tied or twisted. If the last dorsal nerve cross the incision, it, together with its accompanying vessels, should be drawn aside and left untouched if possible. The lumbar fascia is next slit up on a director. The peri-renal fat, which now bulges into the wound, is torn through. With two large retractors opening up the wound, the surgeon continues to tear through the above fat ‖ till he can see, or easily feel, the posterior surface of the kidney. Injury to the peritonæum (p. 128) is best avoided by keeping close to the outer edge of the quadratus lumborum. During this first stage of the operation the surgeon will find sometimes that the muscles are much thickened by reflex irritation from the presence of the stone, and, if the stone has been associated with suppuration and peri-renal inflammation, the tissues will be more or less densely blended and matted together.

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[*] Quoted by Dr. Lange, *loc. supra cit.*

[†] Dr. Holl found that in quite a considerable percentage the last rib is so abnormally short that it does not reach as far as the outer border of the sacro-lumbalis, or so rudimentary that in some cases it more resembles a transverse process; and that in these cases the lower edge of the pleura passes from the lower boundary of the last dorsal vertebra almost horizontally towards the lower edge of the eleventh rib.

[‡] *Annals of Surgery*, vol. ii., Oct. 1885, p. 286.

[§] In other cases the reverse condition may be present; though the last rib be rudimentary, the pleura may pass from the lower edge of the eleventh dorsal vertebra horizontally towards the eleventh rib, and thus be altogether out of danger.

[‖] If this fat is very abundant, some of it should be carefully torn away; poorly vitalised, it is prone to suppurate tediously and to delay healing.

An assistant now makes powerful pressure on the opposite side of the abdomen, so as to keep the kidney up into the wound, this being widely opened by full-sized retractors, aided, if needful, by an assistant pulling up the lower ribs with his hand. Thus the surgeon is enabled to examine the organ, which is done systematically: the finger is first directed to the pelvis, then to the posterior surface; next, by passing the finger round the outer border, to the anterior surface, which, as Mr. Howse has pointed out (*Clin. Soc. Trans.*, vol. xvi. p. 93), can be done effectually by pressing the kidney back against the firm, unyielding psoas. The sensation given by a stone has been compared to that of the uncut end of a pencil (Morris), or the last joint of a finger (Howse).

If the above means fail, the incision must be made sufficiently free, especially in a fat patient, and a deep loin, to expose the kidney more thoroughly. Additional room may be gained by converting the usual lumbar incision into a T-shaped one, or by making use of König's incision, in which the muscles are cut through as far as the rectus, and the peritonæum pushed forwards, or, as recommended by Morris, continuing the original incision downwards and forwards to a point one inch above and in front of the anterior superior iliac spine. A small stone in the kidney will always be liable to be overlooked; but a surgeon does not give his patient or himself a fair chance who is content with exposing part of the kidney through a limited incision, and then trusting to punctures with a needle.

If the stone cannot be felt either in the pelvis or after palpation of the posterior and anterior surfaces of the kidney, this should be drawn up and out of the wound as far as possible, and again examined, a careful watch being kept upon the pulse.

When the kidney cannot be brought out on to the loin, the incision should be made large enough to see what is being done.

If no stone can be felt by the exploring finger, a needle firmly held in Spencer Wells's forceps should be thrust into the different parts of the organ, exploring it by successive punctures made at short distances; twelve or more such punctures may be made.

All the above, including palpation of the kidney between the finger and thumb, failing, the kidney itself or the pelvis* must be incised, and explored with a sound and the finger. During this part of the operation, hæmorrhage is prevented either by compressing the renal vessels between the left thumb and index finger, or, as advised by Cumston of Boston (*Ann. of Surg.*, vol. xxvi. p. 320), by means of a special clamp which he has devised for the purpose. Cumston finds that pressure may be kept up by this means as long as half an hour without harm resulting, the operation being accomplished without any loss of blood. A free incision is made through the convex border of the kidney into the pelvis, and a thorough and systematic examination of each calyx carried out by means of the index finger or a short-beaked child's bladder-sound. The beak should be not more than a third of an inch in length, a stem of about seven inches, and the size of a No. 3 English catheter. The position of the calculus having been made out, it is removed, if small, through the incision in the convex border of the kidney. If this is inconvenient, or the stone large, an incision is made directly over it, and the stone then removed. It is quite immaterial whether this incision is made into the renal parenchyma or the pelvis, provided that it is sutured afterwards.

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* In the following case, under the care of Mr. T. Jones, of Manchester (*Med. Chron.*, June 1887, p. 212), opening the pelvis alone sufficed to find the stone, after systematic exploration of the kidney had failed: "The forefinger was passed to the anterior surface, and the organ grasped between the finger and the thumb; nothing, however, could be found. The kidney was then carefully explored by systematic puncture with a long needle, also passed towards the pelvis, but no calculus could be felt. An incision, sufficiently large to admit the tip of the index finger, was then made through the kidney substance into the pelvis by means of a fine bistoury. On introducing the forefinger, a small stone was discovered firmly lodged in one of the superior calyces. Small, straight, lithotomy-forceps were introduced, and the stone thus removed." Very free hæmorrhage attended the above incision, but it yielded to pressure made with carbolised sponges, and kept up for five minutes. The patient made a good recovery. The calculus, consisting of lime oxalate, weighed twenty grains. This plan of opening the pelvis might be thought

If the stone is irregularly branched, some laceration of the kidney tissue may be spared if the calculus is broken up and removed in two or more fragments. In this case the bed of the stone should be freely washed out with hot boracic acid lotion or Thompson's fluid,[*] so as to check oozing and remove all *débris*.[†] Mr. H. Morris (*Brit. Med. Journ.*, Nov. 16, 1889) thus alludes to two difficulties which these stones may cause:—"A large branched calculus may be so tightly embraced by the kidney substance, and the kidney may be so uniformly even on its surface, that nothing more than a very firm tough organ may be thought to be present, and even on passing a needle into it no sense of calculus, but rather the resistance of a tough fibroma, is met with. In these cases much difficulty will be experienced in freeing the stone from its encasement, and for this purpose the moderately free use of a bistoury will be requisite. It is astonishing how some of the large branches of a calculus may escape detection unless the surgeon is aware of the firmness with which they are embraced by the tough renal tissue. After removing several large pieces of calculus I have, in one or two cases, thought that all must have come away, because with my finger in the kidney nothing but renal tissue could be felt, and yet, after scratching through at some points where the resistance was greater than elsewhere, branch after branch of calculus has been exposed, showing that more of the calculus would have been left behind than had been removed had the operation been discontinued, because no

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to cause a risk of leaving a urinary fistula, but the numerous cases in which calculi have been removed from the renal pelvis with entire success do not support this view. If the pelvis be dilated this spot should be chosen, otherwise I generally incise the convex border at its lower part, at a spot more readily kept under notice if much bleeding follow.

[*] Water, 4 oz.; glycerine, 4 oz.; borax, 2 oz. To be diluted with water to 1 in 10, or 1 in 4, according to the condition of the part syringed. Solutions of carbolic acid or mercury perchloride should be avoided in such cases, for fear of irritation or absorption. The temperature of the fluid should be about 110°.

[†] Mr. Kendal Franks (*Lancet*, 1880, vol. ii. p. 1223) thus removed, piecemeal, a friable stone weighing 171 grains, and composed of lime carbonate and phosphates. In this case the urine had been fœtid, though acid. The wound healed by first intention. In cases of piecemeal removal of calculi, especially when friable, a certain amount of doubt will often remain as to the entire removal.

further actual contact with the calculus was made with the finger in the interior of the kidney."

If the kidney be enlarged, with expanded calyces, the result of calculous hydronephrosis or pyonephrosis, on searching through the pelvis after a stone, the gush of fluid and collapse of the expanded kidney may cause the stone to disappear, and thus lead to much trouble in its removal (Symonds, *Clin. Soc. Trans.*, vol. xviii. p. 181).

Mr. Morris (*loc. supra cit.*) gives two other conditions which may prove embarrassing. "Sometimes in feeling over the kidney a portion of it, varying in size from a sixpence to a five-shilling piece or more, is found soft, flaccid, thin or fluctuating, and there is nowhere any sense of hardness or increased resistance, such as might be expected from even a phosphatic stone. On incising or puncturing this soft part, pus or purulent urine is drawn off, but no stone is felt; but on introducing the finger into the interior of such an organ, a small calculus may be detected, freely movable within an enlarged pelvis, or fixed in a dilated calyx, or possibly at the apex of a funnel-shaped pelvis. Such cases show that aspiration, or simple incision and drainage, are insufficient, and that one ought not to be satisfied with anything less than a digital examination of the interior of the pelvis, of the calyces and commencement of the ureter. Another arrangement of the calculus is sometimes found in sacculated kidneys. The renal cavity may be wholly or partially filled by a soft, mortary, phosphatic calculus which gives no sound or resistance to the scalpel or trocar, and yet, on incising the renal substance and inserting the finger, a stone of considerable size may be felt."

One more difficulty, which must, however, I think, be a very rare one, is inability to reach the pelvis in a stout patient. Mr. Mansell Moullin relates (*Clin. Soc. Trans.*, vol. xxv. p. 57) a case of this kind:

The patient, a lady, aged about 40, and rather stout, had suffered for ten days from total suppression of urine, believed, and correctly so, to be due to a calculus having blocked the upper end of the ureter of the only kidney which remained functionally active. The left kidney was explored by the usual lumbar incision. "There was no difficulty in finding the kidney, although it seemed to lie unusually deep. Its surface was smooth and uniform, but very firm, and it was not possible, either by rolling the patient on to her back, or by hooking the kidney outwards, to pass the finger sufficiently far on to the anterior surface to feel the pelvis. The kidney was punctured and explored by dressing-forceps and sound, but no stone detected. The operation was successful in that urine soon began to escape, but the patient sank with pyelitis and increasing asthenia on the twenty-third day. The necropsy showed no trace of a right kidney. The left was much enlarged, and an oval uric-acid calculus was impacted in the ureter at its commencement, lying nearly in the middle line of the body.

If after free incision and thorough exploration of the kidney no stone is found, the ureter must next be explored throughout its whole length by passing a No. 3 English bougie or catheter down it into the bladder. The catheter may be passed through the incision in the kidney into the ureter. If, however, the orifice of the ureter cannot be hit off in this way, Morris advises a small puncture in the posterior aspect of the infundibulum, through which the catheter can be then easily passed into the ureter. After the exploration this incision can be closed by a catgut suture.

Should a stone be found to be impacted in the ureter, it must now be exposed and removed. The following description of the methods of reaching the different parts of the ureter is chiefly based on the lines laid down by Morris:—The original oblique incision is prolonged downwards and forwards to a point one inch above and in front of the anterior superior iliac spine, and, if necessary, still further forwards towards Poupart's ligament, and then, parallel to this structure and one inch above it, as far as the level of the internal abdominal ring, or even farther. Through this incision both the abdominal and pelvic portions of the male ureter can be exposed, and the abdominal part and upper half of the pelvic portion in the female.

Since the ureter is frequently dilated behind a stone, after the calculus has been reached with the finger in the manner described, it can generally be gradually pushed up the dilated ureter towards the kidney. If possible this should be done, for two reasons: in the first place, the higher in the ureter the more accessible will this structure be for removal of the stone and suture; and, secondly, damage to a portion of the ureter already probably inflamed or ulcerated by the calculus will be avoided, and thus more rapid healing ensured.

In order to remove the stone the ureter must be incised over it in a longitudinal direction with a sharp tenotome. The wound in the ureter is then immediately closed by means of Lembert sutures passing through the outer coats only, the number of sutures depending on the size of the incision in the ureter. Incisions made into the kidney can usually also be sutured. When, however, the kidney substance has been much lacerated in the removal of a large calculus, sutures are better dispensed with. For incisions into the infundibulum, Lembert sutures of fine catgut are employed. Incisions in the renal parenchyma may be closed in the following manner:—Several sutures of medium-sized catgut are used (if too fine, they will cut through). They are passed deeply through the kidney by means of large, fully-curved needles, three to five sutures being used, according to the size of the incision.

These sutures are passed and tied before the compression of the renal vessels is relaxed, Cumston (*loc. supra cit.*) suturing the kidney before removal of the clamp. In this way two very important advantages are gained—the prevention of hæmorrhage from the kidney, and also usually the prevention of leakage of urine; the result is that primary union of the incisions frequently takes place, and rapid healing of the whole wound and early convalescence thus ensured.

A drainage-tube or a strip of iodoform gauze is now passed down to the kidney or the incision in the ureter, in order to allow of free drainage should leakage of urine occur. The rest of the wound is then closed, the muscles being first brought together by buried sutures.

If, however, the kidney has been much lacerated, or if for any other reason no sutures are placed in the kidney, a full-sized drainage-tube must be passed down to the kidney in order to allow of free drainage; or if there is free oozing the wound may be packed with iodoform gauze, which is left in position for twenty-four hours. The ends only of the wound must be sutured in this case, and the dressings changed as often as they become soaked with urine.

A stone may be missed at the operation, and come away from the wound, or be passed later on *per urethram*. An instance of the former is given by Mr. Bruce Clarke (*Illus. Med. News*, p. 4). The latter happened to me in case No. 9 in the table (p. 138).

After-treatment.

The chief points here are: 1. The meeting of shock after a prolonged operation. 2. Changing of the dressing at sufficiently frequent intervals at first, according to the amount of urine and blood which soak through. 3. Gradual shortening of the drainage-tube instead of entire removal, especially where there has been much interference with the surrounding parts, or where pus, &c., have been present in the kidney. 4. Avoidance of all chills. 5. Appropriate food, mainly the blandest fluids in regulated amounts, especially where the condition of the other kidney is doubtful.

Lastly, it may be pointed out that the life-histories of these cases should be followed up most carefully, to see how far the cure remains a complete one; to aid this, the patient should pay lifelong attention to his diet, habits, exercise, &c.

Difficulties in Nephro-lithotomy.

1. An insufficient incision. 2. Abundant fat—*e.g.*, in the subcutaneous tissues, around the kidney, and extra-peritoneal, rendering the wound very deep. 3. Rigidity, and perhaps thickening, of the muscles, due to the irritation of the stone. This condition was present in a very marked degree in a patient from whom I removed the smaller calcium-oxalate calculus (Fig. 40). No amount of anæsthetic seemed to have any effect on this condition. Fortunately the loin was a thin one, and the stone very obvious on reaching the pelvis. 4. Matting of the parts around the kidney, rendering it difficult to explore this organ, its different parts and relations, exactly. 5. An indurated condition of the kidney itself from the irritation of a stone. 6. Troublesome flatulent distension of the colon. This is not at all uncommon. The bowel should be packed away with sponges fastened on to silk, and pushed deeply into the front of the wound. 7. Opening the peritonæum. This accident occasionally occurs in difficult cases. If the wound be kept aseptic, there will be no serious consequences.

In case 11 of the series below, I opened the peritonæum under the following circumstances: The week before, in No. 10, the kidney lay very high up under the ribs. In No. 11 it was placed very low, closely surrounded by the colon, and with its lower end in the left iliac fossa. It was also the seat of a small hydronephrosis, and therefore soft and yielding. On slitting up the lumbar fascia the descending colon came into view with a soft mass behind it, which I took for pultaceous fæcal contents. I accordingly explored with my finger higher up, and under the ribs found a body firm and fleshy, with a feel like the kidney, but too small. This proved to be the spleen, unusually movable. The opening in the peritonæum was kept covered by aseptic sponges, and the mass behind the colon investigated. This proved to be the kidney, extremely low down, and containing a calculus in the pelvis, this last being also distended with fluid. For the first few days I kept strips of sal alembroth gauze, changed two or three times in the twenty-four hours, tucked up under the ribs, and stitched the low-lying kidney well up into the wound, so that the urine should escape freely. The patient recovered without a bad symptom. Smaller openings should be tied up with chromic gut, or sutured with the same.

8. A stone present, but very difficult to detect. This may be due to (*a*) its small size, especially if it lies deeply in a calyx, or is surrounded by very indurated kidney tissue. A very small stone may cause severe symptoms. This was proved by some of the cases in the table given at p. 138.

Thus, in Case 5, a stone, weighing but fourteen grains, and situated in the top of the ureter, quite incapacitated the patient from any work. In case No. 8, another very small stone, firmly fixed in a calyx at the upper part of the kidney, caused severe hæmaturia and pain.

The following case, under the care of Dr. Murphy, of Sunderland (*Brit. Med. Journ.*, vol. i. 1891, p. 757), shows still more clearly what urgent symptoms a tiny calculus may cause:

The patient, aged 39, had been a complete invalid for nine months, owing to repeated attacks of renal colic, which morphine failed to relieve, the administration of chloroform being frequently required. At the operation, "a very small stone about the size of a hemp-seed, escaped with a flush of blood," when the kidney was, incised. The site of the stone is not given. A good recovery followed.

How impossible it is to detect some stones, without incision of the kidney, is shown by a case published by Mr. Morris: *

This authority, with all his experience, after thoroughly exploring the kidney, compressing it all over with the finger and thumb, and also after puncturing it, failed to detect a stone which lay in a hollowed-out calyx. Though the calculus was the size of a small marble, it was so thickly surrounded by kidney-tissue that, even after the removal of the kidney, the position of the stone could not be detected by pressing on the kidney with the fingers as it lay on a table. The patient made a good recovery.

(β) A sacculated kidney, into one of the sacculi of which a small stone may fall and be hard to find (p. 126).

9. A stone on the anterior surface of the kidney, especially if near the entrance of the vessels. 10. A very large or a branching stone (p. 125). Mere size does not necessarily create difficulties in extraction, though, owing to the changes entailed in the kidneys, the general health, etc., by the long duration of a calculus, the prognosis is rendered very much less favourable. Thus, in the calculus (Fig. 40) weighing 473 grains, or very nearly an ounce, the very bulk of the stone rendered its detection easy; it was readily loosened from the much dilated pelvis with lithotomy forceps. A branched calculus presents, of course, much greater difficulties (p. 125).

Mr. Bennett May has published (*Clin. Soc. Trans.*, vol. xvi. p. 90) an excellent instance of this kind, in which he successfully removed a very large, somewhat S-shaped calculus from a man aged 34, with symptoms of sixteen years' duration. Though the stone weighed 473 grains, and was three inches long, manipulation failed to make it out distinctly, but acupuncture detected it at once.

Mr. Footner, of Tunbridge Wells, removed a calculus weighing 822 grains, or nearly two ounces. The patient made a good recovery, but a sinus persisted, through which, on two occasions, a millet-seed calculus was passed (*Brit. Med. Journ.*, 1892, vol. ii. p. 69). A calculus far exceeding the above was brought by Mr. D. Day, of Norwich, before the Clinical Society (*Trans.*, vol. xxvi. p. 24). This calculus, mainly phosphatic, weighed 1331 grains. The patient made a good recovery, with a sinus persisting in the loins. A calculus larger than either of these is mentioned at p. 134.

11. A stone which breaks up readily (p. 125). Another condition allied in difficulty is where a calculous deposit rather than a distinct calculus is present. This is more grave, as the deposit here will usually

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* *Med.-Chir. Trans.*, vol. xlviii. p. 69. The woodcut (p. 73) shows well the relation of the stone to the surrounding kidney.

be phosphatic, and point to co-existing pyo-nephrosis. 12. Multiple calculi. Stones (usually minute in size) numbering over 60 or 100, have been removed on several occasions. In such cases it is always possible that the minute calculi have been retained, owing to a larger calculus—*e.g.*, in the pelvis or ureter—blocking their exit. 13. A very mobile kidney. The importance of having an assistant to push the kidney well up into the wound has already been insisted on. It is essential to have this done both for detection of the stone and for its removal, in order to avoid needless disturbance of the surrounding parts, or the kidney may be secured with sutures at the commencement.

Mr. May (*loc. supra cit.*) explains the remarkable fact that his large stone was not felt when the kidney was thoroughly exposed, by the fact that the organ fell forwards and thus embarrassingly increased the depth of the wound.

14. A kidney situated very high up under the ribs (p. 128). 15. A kidney, the pelvis of which it is difficult to reach owing to the stoutness of the patient, as in the case given at p. 126.

Question of Nephrectomy during a Nephro-lithotomy.—In several of the above conditions the question of the advisability of removal of the kidney will arise—*e.g.*, where the kidney has been much handled and repeatedly incised, where the stone is large and branched and difficult of removal, where many stones are present, or where one is present and very friable, where the kidney is much altered by pyo- or hydronephrosis, and, finally, where the surgeon is certain a stone exists but cannot find it, as in Mr. Morris's case already alluded to at p. 129.

In such cases the surgeon will be guided by the age of the patient; the knowledge he possesses as to the condition of the other kidney (the amount of urine, the percentage of urea, etc.); the degree to which the kidney he is operating on has been disturbed from its relations, and its structure interfered with; the amount of disease, *e.g.*, number of sacculi, condition of pus contained in them, the thinning of the cortex, etc. When the surgeon is certain, from the history and failure of previous treatment, that a stone exists which cannot be found, he must be chiefly guided by the degree to which life has been made miserable. Finally, the length of time that the operation of nephro-lithotomy has already lasted, and the condition of the patient, must be taken into account. Where the patient is young, where the other kidney is healthy, where the kidney operated on is much damaged either by previous disease or by manipulation added to disease, where several stones are present, nephrectomy, either now, or a little later, is indicated; of these, immediate removal of the kidney is preferable if the patient's condition admits of it.* But the question is a very different one where the kidney is a large one after its fluid contents as well as a stone have been removed; or where it is a case of multiple calculi in a suppurating, damaged kidney. Nephrectomy should, as a rule, be deferred here, and the kidney thoroughly drained, for (1) additional shock and loss of blood will be avoided. (2) The condition of the opposite kidney, very possibly calculous also, will be made clearer by waiting. (3) The bulk of the kidney will be lessened by drainage. (4) Though a source of discomfort (if an open sinus persist) it may still do some and important work.

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* An instructive case which was under my care illustrates well many of the above difficulties—viz., multiple and large calculi, a mobile kidney, the question of nephrectomy arising during nephro-lithotomy, and the formation of multiple calculi in one kidney without symptoms. In February 1888 I was asked by Dr. Goodhart to see a case of probable renal calculus. The boy, aged 15, had been admitted with abdominal pain and grating of an indistinct and delicate nature in the left renal region. This kidney was slightly enlarged. When asked to localise his pain, the patient pointed to the region of the *left* kidney and the *left* loin. This kidney being explored was found to be occupied by irregular nodulated masses. A hare-

Causes of Death after Nephro-lithotomy.—Very few unsuccessful cases have been published; the following appear to be most probable causes of after-trouble:

1. Hæmorrhage. A most interesting case of hæmorrhage, fatal on the seventh day after nephro-lithotomy, was brought before the Clinical Society (*Trans.*, vol. xxii. p. 214), by Dr. Stevenson and Mr. Butler Smythe:

> Several small and one larger stone (this one being tightly fixed in the pelvis and ureter) having been removed from a kidney, the site of hydro-nephrosis, the patient did well, save for a temperature which was 103° on the third and fifth days and all along very variable, until the sixth day, when bright blood and urine were passed both by the urethra and by the wound. On the seventh day about half a pint of bright bloody urine was drawn off from the bladder, and death took place soon after, with symptoms of internal hæmorrhage. The kidney was found enormously distended with blood-clot and bloody urine. The opening made at the operation was small and blocked up by clot. Embedded in the kidney substance, close to the pelvis, was a round spiked calculus, which had ulcerated into a branch of the renal artery just at its entrance into the kidney, and had given rise to profuse bleeding into this dilated organ.

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lip pin at once came on and between calculi. The kidney being incised, hosts of calculi, comparable only to a gravel-pit, were found in the calyces and pelvis, the chief nests being at the upper and lower extremities. The former of these, lying as they did high up under the ribs, gave much trouble. To get at them the kidney-tissue was again scraped through directly over them, and many of them thus reached. The chief difficulty of the operation, in addition to the number of stones, was the great mobility of the kidney, though this organ was well pushed up from the front. The condition was perhaps due to the almost entire absence of surrounding fat. When I realised the condition of the kidney, I expressed myself in favour of nephrectomy, as the organ was almost useless, as the stones were so numerous, and as a prolonged attempt at removal would produce more shock in so weakly a subject. One or two less important points in favour of nephrectomy were the mobility of the kidney and the entire absence of adhesions. Dr. Goodhart's counsel was, however, against this step, owing to the small percentage of urea—this had never been above 1·2 per cent., and often less. I accordingly continued; when forty-six calculi had been removed and the operation had lasted three-quarters of an hour, the pulse failed so ominously that I was obliged to desist. Very little blood escaped as long as the opening was plugged with the finger, but considerable oozing followed as the finger brought out the stones. The patient never rallied well, and died three hours and a half after the operation. The necropsy showed a little ecchymosis around the left kidney; this still contained calculi at its upper and lower parts. The *right* kidney, of which the boy had never complained, also contained a large number of stones. Its substance, though much wasted, still contained a fair amount of secreting substance. The condition of the opposite kidney thus abundantly justified my old friend's opinion. Feeling that unsuccessful cases of nephro-lithotomy have not been sufficiently published, I brought this and the case at page 132 before the Clinical Society. A detailed account of each will be found, with ten others, in the *Transactions*, vols. xxii. p. 198, and xxiv. p. 155.

The following possible causes of hæmorrhage after nephro-lithotomy must also be remembered:

In case No. 19 in the table, p. 139, the patient was a young Welsh miner, with all the symptoms of renal calculus well marked. At the operation two calculi were easily found and removed from the lower part of the right kidney. About three hours after the operation the usual soakage of urine had taken place through the dressings; but it was noticed to be unusually brightly stained with blood. When the dressings were removed blood was seen to be trickling through the tube which I had left in contact with the wound made in the lower part of the outer border of the kidney. Dr. Bligh, now of Caterham Valley, and then house-surgeon, plugged the wound, and, the patient passing into a state of collapse, resorted to saline infusion. On my arrival at this time, I found that the patient had partially rallied. Similar bleeding followed about two hours later, the wound was replugged, and transfusion again resorted to; but the patient sank seventeen hours after the operation. At the necropsy nothing was found in the wound beyond some coagula and ecchymosis round the kidney, and a very small calculus, which I had overlooked when the two others were removed. There was marked contraction of the mitral valve. It is very difficult to estimate the loss of blood in such a case, but it was thought not to exceed six or seven ounces, and there were no coagula. The operation was of the simplest kind, but the marked pallor of the patient's face ought to have led me to inquire for a cause beyond that which I too readily took for granted, viz., the pain, etc., set up by the renal calculi. I am not aware of any case that has been published in which surgical hæmorrhage has been associated with a contracted mitral valve, but I have been given to understand that parturient women with the above lesion are especially liable to the peril of flooding.

Another possible cause of hæmorrhage after nephro-lithotomy is where calculi are associated with a growth in the pelvis of the kidney. Mr. Battle has recorded a most interesting instance of this (*Brit. Med. Journ.* vol. i. 1895, p. 1206):

At a lumbar nephro-lithotomy several oxalate calculi were removed and a villous growth scraped away from the lower anterior aspect of the pelvis. The patient resumed work, but the hæmaturia returned and became profuse and constant, and the kidney was removed about eighteen months after the first operation. The surface about the pelvis was papillated and firm, and the microscope showed evidence of a new growth at this spot, but whether this was a simple papilloma or a squamous epithelioma remained doubtful.

2. Cellulitis. If it has been needful to incise or tear the kidney freely, if the urine is foul, and the bleeding has been arrested with difficulty after imperfect and repeated plugging, this may be readily brought on. Other causes of this will be found in much disturbance of the wound or fingering by many hands.

3. Uræmia, if the other kidney is the site of calculous disease or disorganised. This was chiefly the cause of death in the case in which I removed the large stone (Fig. 40).

The patient was a solicitor, aged 58, of sedentary life, and gouty history, who had suffered from attacks of right renal colic off and on for upwards of thirty years,* these attacks having become increasingly fierce for about six months. Occasionally he had had slight pain on the left side, and on the morning fixed for the operation he passed two small, fawn-coloured calculi of lithic acid and lithates. These were quite insufficient to account for all his suffering, and as prolonged and careful treatment had entirely failed, and as his "life was not worth having at the price," the operation was proceeded with, and the huge renal calculus figured removed. This was effected with the utmost ease, as the stone, from its size and hardness, was readily detected occupying the distended pelvis of the kidney. A profuse jet of venous blood followed its removal with lithotomy forceps, after it had been loosened by a scooping movement of the finger. The hæmorrhage was at once arrested by sponge-pressure kept up for a few minutes. All went well for the first week, save for persistent oxaluria, which no treatment could remove. The patient was able to sit up and read; appetite returned, and the wound was healing well. On the sixth day a change for the worse set in, first much flatulence and nausea, then constant restlessness, followed by coma, ending in death on the morning of the eighth day. I cannot doubt that the opposite kidney was here also the seat of stone, and its tissue too much impaired to admit of recovery, though I was unable to obtain a post-mortem examination to verify this. I should add that the urine in this patient before the operation was acid, of sp. gr. 1018, and without sugar or albumen. The quantity passed was natural, and the urea sometimes normal, sometimes slightly deficient.

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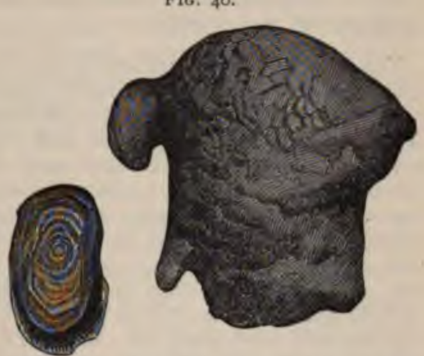
* This long duration of symptoms was unfavourable. Mr. Keetley was more fortunate in a case equally long standing, in a much younger patient (*Brit. Med. Journ.*, vol. i. 1890, p. 134. A gentleman, aged 44, for thirty years had not passed twenty-four consecutive hours without pain. Mr. Keetley removed 150 calculi from the right kidney. A large rough calculus had blocked the way into the ureter for the numerous smooth calculi which formed behind it. The patient made a good recovery.

FIG. 40.



The larger calculus is the one mentioned here in the text. It weighed 473 gr., and consisted of lithic acid and lithates. The main mass lay in the dilated pelvis, the processes fitted into the calyces. The smaller calculus, composed chiefly of oxalates, was successfully removed from a patient aged 24. It weighed 42 grs. The two are good instances of what nephro-lithotomy can, and what it cannot do, without grave risks.

Dr. Whipham and Mr. Haward (*Clin. Soc. Trans.*, vol. xv. p. 123) have recorded a case which, with my own just given, points urgently to the importance of surgeons being permitted to explore earlier:

The patient, aged 56, had for "several years" been troubled with "gravel." The symptoms here were chiefly indicative of calculous mischief in the left kidney, but there was some tenderness on the right side as well. The urine here was 1006 sp. gr., alkaline, and contained pus. The left kidney was explored, and found in a state of pyo-nephrosis; no calculus was found, but a copious discharge of pus took place soon afterwards, giving great relief. The patient a little later again lost ground, and the wound was thoroughly explored a second time, but the patient sank a few hours after this, a month after the first operation. The left kidney-pelvis was much dilated in its upper part, and communicated with a large peri-nephritic abscess. The right kidney contained a large branching calculus.

4. Septicæmia. This condition may be induced by the wound becoming foul, a complication which can always be prevented after removal of small stones from healthy kidneys. But where pyonephrosis exists, it may be impossible to keep the wound sweet from the first. This was so in Case 6 of the subjoined table.

Here, after removal of nine calculi, I was obliged to remove the kidney a year later, owing to the persistence of a fœtid sinus.

And it is to be noted that septicæmia may occur after a nephro-lithotomy, successful as far as the removal of the stone goes, after a considerable interval, where pyo-nephrosis coexists. This is an additional reason for carefully considering the advisability of performing nephrectomy in such cases.

Dr. Shepherd, of Montreal, has published* a very interesting instance of this kind:

Nephro-lithotomy was performed in a patient aged 26, who had suffered from symptoms of stone for seven years, with no tumour, and pus in the urine. An enormous, unbreakable stone of triple phosphate was removed with much difficulty from the left kidney. It weighed 4 oz. 7 dr., and measured 3½ inches in length and 9 inches in circumference. The tissue of the lower part of the kidney exposed seemed healthy, and no pus being evacuated it was thought best not to remove the organ. The wound continued to discharge pus, and the temperature varied correspondingly for three months and a half after the operation, when septicæmia set in and proved fatal. The necropsy showed that the upper part of the kidney, which was not exposed, consisted of large communicating sacs, containing over 10 oz. of fetid pus, and a number of irregular branched calculi. Dr. Shepherd points out that the fatal septicæmia was undoubtedly due to these abscesses, showing the need of thorough exploration in all cases where a large stone has set up grave changes, and of extirpation in most of them.

I have described lumbar nephro-lithotomy fully because I believe that, on the whole, it is much the safer operation for the great majority of operators. But, to make the account complete, reference must be made to the proposal that **abdominal** should replace lumbar **nephro-lithotomy.**

As might be expected, this proposal has come from a specialist in abdominal surgery. Mr. K. Thornton (*Harveian Lectures*, "Surgery of the Kidneys," p. 34) gives the following reasons for preferring his combined method: "Recognising the difficulty in the diagnosis of a stone, and the still further complication introduced by the transference of pain in some cases to the opposite side, and the importance of being able to examine the other kidney and both ureters thoroughly, throughout their whole course, I proposed to open the abdomen by Langenbüch's incision over the suspected kidney, examine carefully both kidneys and ureters, and, having found a stone, to employ one hand in the peritonæum to fix the kidney and stone, and guard the colon, while with the other I could cut down upon the stone directly from the loin, merely making an opening through the loin tissues large enough to introduce the finger and necessary forceps for the extraction of the stone." And again, at p. 36: "We are certain that the patient has the usual allowance of kidneys. The chances of overlooking the stone, if there is one present in either kidney, is reduced to a minimum. I do not say that the abdominal handling is absolutely infallible, but in fourteen operations I have only once failed to find a stone, and the recovery and present health of this one patient make it highly improbable that there was, or is, a stone in her kidney. This result compares very favourably with the large number of unsuccessful lumbar explorations already recorded."

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* *Philadelphia News*, April 23, 1887; *Annals of Surgery*, vol. vi. August 1887, p. 185. The right kidney is stated to have been perfectly healthy, but double its normal size.

No one who has seen much of lumbar nephro-lithotomy would allow the above remarks to pass uncriticised.

While I am fully aware of the difficulties in determining whether a stone is present, and in what part of the kidney it lies, I am convinced that every year that goes by will perfect our power of diagnosis, by making clearer to us the conditions that simulate stone. "The large number of unsuccessful lumbar explorations" of which Mr. Thornton makes a strong point is not quite correctly referred to by him. He implies that a stone was there, but that operators making use of lumbar nephro-lithotomy failed to find it. Now this is not quite the case. In the great majority of cases no stone was present. They were cases in which the diagnosis was at fault. It has always been so with every new operation, and is one of those faults which time alone puts straight. In reality, these failures to find a stone are rather creditable to the lumbar operation. The operators have been of the most varying degrees of experience, and the great majority of their cases* have recovered. Would this have been the case if the explorations had been through the peritonæal cavity with "the necessary manipulations to examine the kidneys and ureters"? Now, on this hangs one of my chief points. No one who knows anything of what Mr. Thornton has done for abdominal surgery will doubt for a moment that operations on the kidney through the peritonæum are certain to be as safe in his hands as any such operation can be. But what this book has to try and teach is what operation is the safest for the largest number of operators. I cannot agree with Mr. Thornton that the increased risk due to the opening of the peritonæum is practically *nil*—*i.e.*, if the surgeon will take the pains to perform a thoroughly aseptic operation. I should agree that the risk of peritonitis is now much smaller than it was, but there are other risks which are inseparable from this mode of exploring the kidney.† I refer to the shock which the necessary manipulations of certain very vital parts must entail. Mr. Thornton will be able to go straight to the kidneys with a minimum of disturbance of the overlying parts. But is it to be believed for a moment that this would be the case with the majority of operators? And this brings me to another point. Others who have tried this method have not found it so easy to detect the presence of a renal calculus or to determine the condition of the kidneys. With regard to the latter point, I may mention the following:

A woman was sent to me with long-standing pyuria of renal origin. She was clearly very near her end from kidney failure, and during the five days she lived no operation was admissible. After her death I thought it a good opportunity to investigate the condition of the kidneys by an abdominal incision. I was able to feel that there was a right kidney, which felt so hard that I thought it contained a stone. About the condition of the left kidney I was quite unable to satisfy myself. The necropsy showed that the right kidney was in a condition of fibroid atrophy; no stone was present. The left was a thin-walled sac containing pus. Owing to the great tenderness on this side, I had looked on this kidney as the source of the pyuria. It would have been readily reached from the loin.

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* I have pointed out (p. 131) that there is reason to fear that fatal cases have not been published. But this would not apply to the lumbar operation only.

† Every one who has seen much of renal surgery will know that grave shocks may readily be met with in some of these explorations of the kidney. Thus, in the case of nephro-lithotomy (No. 12 in the table, p. 138) in a lady of 40, with fifteen years' history, from whom I removed three cystine calculi, the patient was so anæmic and unhealthy from her long-continued pain and marred life, that she nearly succumbed during the operation. Yet this was of the simplest, the loin thin, the calculi (387 gr.) found at once and extracted easily, the operation itself not exceeding twelve minutes. A.C.E. followed by ether had been given, but the pulse, always weak, became almost imperceptible after the first incision.

I have only once tried to detect a renal calculus through an abdominal incision.

The case was No. 21 in the table at p. 139. As, in addition to the renal symptoms, there was trouble indicating oöphorectomy, I took the occasion, after Dr. Galabin had removed the ovaries, to explore the left kidney, where the presence of a stone was suspected. The existence of a calculus, which felt a large one—in reality, three were present—and of a small hydro-nephrosis could be made out, conditions which were verified at the time of the nephro-lithotomy a little later.

In this case the kidney was not enlarged, of the ordinary firm consistence, save near the pelvis, and free from the results of past inflammation. In such cases as these it will always be easy to detect the presence of the stone, but it will be very different in those cases where the stone lies in an enlarged kidney, the seat of a collection of fluid, or in one matted down with much thickening of surrounding tissues from long-standing inflammation.

But I would rather quote the opinions of others. Mr. T. Smith (Discussion at the Clinical Society, *Brit. Med. Journ.*, 1887, vol. i. p. 393) said that Mr. Thornton had seemed to represent that by opening the abdomen from the front one could ascertain with certainty whether there was a stone in the one or other kidney. But one could not always tell this even if one felt the kidney out of the body. In three different cases in which he had handled kidneys so removed no stone could be detected therein until the kidneys were cut open.* Another very interesting case, brought by Mr. Page before the Medico-Chirurgical Society (*Brit. Med. Journ.*, 1888, vol. i. p. 795) shows what care is needed when abdominal exploration for the examination of the kidneys is made use of.

Mr. Page thought that in this case abdominal exploration, had he made it, would probably have led him astray, as the left kidney, which, though small, was the working one, would have been removed, while the right viscus, which was really the seat of pyelitis and contained some small stones, would have been looked upon as merely enlarged to do the work of two, this increase in size being really due to its diseased condition.

Mr. K. Thornton (p. 37) mentions a case in which it took an hour to find the kidney by the lumbar incision, and which ended fatally, and another in which the surgeon failed entirely to find the kidney by the same method. Such cases, as shown by their number, are quite exceptional. When the large number of explorations of the kidney by the lumbar method is considered, it will be acknowledged that the lumbar method is characterised by the ease with which the kidney is found, and the well-doing of the cases afterwards, especially when the great number and the diversity of operators are considered.

With regard to pain in one loin due to mischief in the opposite kidney, we have very little knowledge as to sympathy between the kidneys. But this condition is certainly rare. As a rule, in renal calculus, pain is alone complained of on the side in which the stone lies. Pain in both loins means usually stones or disease on both sides, a far graver thing than "sympathy."

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* On this point see Mr. Morris's case, p. 129.

Mr. Thornton, in his combined method, which I have described at p. 134, lays stress upon the small clean cut which is made upon the stone by the loin, only large enough to introduce the finger and forceps. It is difficult to see how such an opening would suffice to remove a small stone lying in a calyx on the anterior surface of the kidney, one of the most difficult of all cases. By the lumbar operation the surgeon would be able, after freeing the kidney, as is nearly always feasible, to bring it out of the wound on to the loin, and carefully handle the anterior as well as the posterior surface. With regard to the risk of the hernia which Mr. Thornton states (*loc. supra cit.*) to be "a not uncommon result of the lumbar operation," the experience of most surgeons will be quite the opposite. As already stated (p. 103), the tissues in the lumbar region are so strong and unyielding, compared with those in the anterior abdominal wall, that a protrusion does not readily take place here.

Exploration of Kidney in Suppression of Urine.—The above condition is so grave when a mechanical cause which medicine can avail nothing is present, the history may be so obscure or perplexing, the call for help so urgent, that some allusion must be made to the subject here. One of the most brilliant examples of what nephro-lithotomy can do in some cases of suppression of urine is shown by a case brought by Mr. R. C. Lucas before the Medico-Chirurgical Society (*Trans.*, vol. lxxiv. p. 129):

> The patient, aged 37, had had her right kidney, a "mere shell, containing masses of stone weighing twenty-one ounces" successfully removed. Three months later she was seized with agonising pain in the back and left loin. Suppression of urine quickly set in, and on the fifth day a calculus was removed which was exactly of the shape to act as a ball-valve to the top of the left ureter. The patient made an excellent recovery.

But in many cases of suppression the indications are less clear, and there is often much difficulty in deciding which ureter is blocked, owing to the deficient history. An excellent instance of such cases, in which the surrounding difficulties were most successfully met, is recorded by Dr. Fraser and Mr. Parkin, of Hull (*Lancet*, vol. ii. 1893, p. 688):

> The patient here suffering from suppression of urine was 74 years of age. Beyond the evidence pointing to obstructive anuria, there was very little to throw light on the condition of the kidneys, or which organ should be explored. As the patient had been observed by her friends to support the left side in walking, and as there was deep-seated tenderness in this loin, Mr. Parkin explored the left kidney from the loin. The organ was enlarged, distended, and hypertrophied. About six ounces of urine escaped when the kidney was incised along its convex border, the last portion to come away being mixed with some pus. No stone was found, and the cause of the suppression must remain obscure, as the patient, though 74, made a good recovery, with a sinus from which most of the urine passed.

The above cases show the importance of knowing the history of the case, and, where this is deficient, making a most minute examination, no point being considered too trivial to be pieced in with others, before

Twenty-one Cases of Lumbar Nephro-Lithotomy.

No.	Medical Men.	Age.	Sex.	Site of Stone.	Weight.	No.	Result and Remarks.
1	Dr. Hale White	23	M.	Pelvis	grs. 42	1	Recovery.
2	Dr. Wilson, Haverfordwest	58	"	"	473	1	Death ninth day. Almost certainly calculi in opposite kidney.
3	Dr. Goodhart	15	"	Throughout kidney	652	46	Death three hours after. Opposite kidney a "gravel-pit."
4	For Mr. Durham*	41	"	Pelvis	78	1	Recovery.
5	Dr. Phillipps, Faversham	53	"	Top of ureter	14	1	Recovery.
6	Dr. G. Newton Pitt	31	"	Throughout kidney	333	8	Recovery with a sinus. Nephrectomy a year later. Recovery.
7	Dr. Todd, Brigg	29	F.	" "	39	9	Recovery.
8	Dr. Cressy, Wallington	22	M.	Calyx at upper part of kidney	22	1	Recovery.
9	Dr. Morley, R.N., Chatham	40	"	?	—	2	I missed both these stones after free incision of the kidney (in two places) and sounding. Both descended a little later. One was passed, the other I crushed. The patient has been perfectly well since.
10	Dr. H. P. Berry, Grantham	33	"	Pelvis	45	—	Recovery.
11	Drs. Fry and Clayton Jones, Shepton Mallet	28	"	"	49	—	Recovery.
12	Dr. L. Stephens, Emsworth	40	F.	"	387 Cystine	4	Recovery. The first and, I believe, the only cystine calculus thus removed.
13	Dr. Pye-Smith	41	"	Pelvis and kidney	1 oz. 2 gr.	—	Recovery. This patient was admitted with a perinephritic abscess, which I opened. I failed to detect the calculus at this time and removed it about three weeks later.
14	Dr. G. Newton Pitt	14	M.	Pelvis	118	1	Recovery.
15	Dr. Morley, R.N., F.R.C.S.	30	"	"	1 Oxalate	1	Recovery. This was the most difficult case of all. The loin was very deep, the kidney lay very high up, and as I tried to draw it down, it began to tear transversely near the junction of the lower end and the pelvis. Thus the stone, never seen, was removed by the finger. Free bleeding recurred at first few dressings. Pyrexia, puzzling after operation, was attributed by Dr. Dowson (R.N.) to West African fever.

* This case had been admitted under Mr. Durham, and I operated during his illness. It afterwards transpired that the case had been sent up to Mr. Lucas.

Twenty-one Cases of Lumbar Nephro-Lithotomy—(continued).

o.	Medical Men.	Age.	Sex.	Site of Stone.	Weight.	No.	Result and Remarks
16	None	23	M.	A calyx	grs. 13	1	Recovery. This calculus was anomalous in site and structure. It was readily detected on the surface by a needle, and, as the kidney felt very hard, I expected a branching calculus. On cutting down on the spot where the grating had been detected I found a very small calculus. This was black in colour, readily crumbling under pressure, and chiefly composed of bloodclot and lime oxalate crystals. During the three years which have followed the operation the patient has had two attacks of colic on the same side. These were much milder than those preceding the operation, and he has been able to continue at his work, but I am inclined to look upon this recovery as probably incomplete.
17	Dr. Pochin, of the Old Kent Road	32	F.	Pelvis and kidney. Pyonephrosis	—	7	Recovery with a sinus. The kidney here was so diseased that nephrectomy was advised, but deferred by the patient. She has not been heard of since.
18	Dr. S. Sunderland	42	"	Pelvis and kidney. Pyonephrosis	—	3	Recovery. When seen two years later there was still pus in the urine. As the disease had lasted over twenty years, it is probable that both kidneys were affected. The scar was quite sound, and no enlargement of either kidney was to be detected.
19	Dr. Naunton Davies, of Pont-y-pridd	35	M.	Cortex	94	1	Death. A needle detected a small stone in the lower end of the kidney. Incision in the convex border. Venous bleeding somewhat free, but arrested by pressure. No plugging thought needful. Hæmorrhage through dressings (no clots), with rapid collapse about three hours after operation. Saline transfusion to four and a half pints, and wound plugged. Rallying of patient. Recurrence of hæmorrhage four hours later. The necropsy showed contraction of the mitral valve, p. 132.
20	Dr. Sutton Sams and Mr. Allworth	34	F.	Top of ureter	45	1	Recovery. The kidney, being very movable, was fixed by the method given at p. 165. I saw this patient a year and a half afterwards, and the kidney could be felt fixed in the loin. There has been no return of her trouble.
21*	Dr. Galabin	42	"	Pelvis and ureter. Pyonephrosis	48	3	Recovery. The chief trouble here was pyrexia and frequent micturition. Dr. Galabin having occasion to perform oöphorectomy, I had the opportunity of examining the kidneys. The dilatation of the pelvis and the presence of the stones were easily detected on the left side. The right kidney appeared healthy. A sinus persisted for some months and then closed firmly. When last seen the patient, instead of being a neurotic, exacting, bed-ridden invalid, was in good health.

* Nos. 2, 7, 8, 12, 15, 20, and 21 were private cases. I was responsible for the after-treatment of all except No. 7.

it is decided which kidney is the working one and now obstructed, and which is obsolete.

Any operative interference should be undertaken, if possible, before the stage of constant hiccough and vomiting, twitching or convulsions, and drowsiness deepening into coma, has been reached.

Before alluding to the operative steps to be resorted to it will be well to remember that the causes of suppression of urine which it is thought may be benefited by surgical interference are various in their nature.

The first and the one most likely to be permanently relieved is a calculus impacted in the pelvis or the ureter of the only working kidney. Another and much less favourable class is that where the only remaining functional kidney is the site of acute inflammation dating to old calculous or tubercular pyelitis. Another class is the traumatic one. Such cases are the following:

Mr. Cock recorded (*Path. Soc. Trans.*, vol. i. p. 293) the case of a young man who died comatose on the eleventh day after an accident. All the symptoms of the original injury and the subsequent peritonitis subsided in a few days, save that the catheter withdrew nothing but blood. The autopsy showed a ruptured single kidney. In Mr. Poland's case (*Guy's Hosp. Reps.*, vol. xiv.) the complete suppression of urine which followed an injury was due to thrombosis of the renal vessels of one kidney, and rupture of the pelvis on the other side.

It will be seen that obstruction by a calculus* is the only one which promises much success to the efforts of the surgeon.

With regard to the operation in cases of suppression, if the patient's condition is good, and if no sufficient history is forthcoming, the surgeon will be justified in examining the condition of the kidneys by an incision in the linea alba, being mindful of the fallacies to which I have alluded at p. 135. If he finds a stone in one ureter he must either push it up to a part where he can cut down upon it by the safer lumbar operation, or remove it from the abdomen by the steps given below, p. 167. If no stone is found, and it is decided to drain the kidney which seems to be the working one, this should be done by a lumbar incision. It is not only safer for the great majority of operators, but it must always be remembered that in these cases of suppression the working kidney is usually a damaged one, and pyelitis may be present with more or less pus in the kidney.

NEPHRECTOMY.

Indications.

i. Cases of renal tuberculosis, preferably as the primary operation and also cases of tuberculous pyo-nephrosis explored previously and drained by nephrotomy, but in which a discharging sinus persists. Here the kidney should be removed when the following conditions are favourable

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* In very rare cases the ureter may be obstructed by a body, perhaps capable of removal, and not a calculus. Mr. Butler, of Guildford, records (*Lancet*, vol. i. 1890, p. 79), a case of suppression of urine lasting thirteen days. The necropsy showed that the ureter of the only working kidney (the left one) was greatly distended with urine and plugged by a solid hard body in about its centre. This proved to be a venous thrombus which, formed in one of the veins in the kidney, had passed through a rent in the kidney tissue into the pelvis and ureter. Here the suppression came on four days after a blow on the abdomen. No symptoms had pointed to renal disease, and, save that the blow was on the left side, there was nothing to tell on which side the obstruction was.

—viz., the age and strength of the patient, the absence of visceral infection, tubercular or lardaceous, and, if possible, a date not too long deferred, for the additional reason that the kidney will be increasingly matted down and difficult of removal, while its fellow may have become involved in the disease.

On this point I may quote again from my paper on the conditions which simulate renal calculus (*Brit. Med. Journ.*, 1890, vol. i. p. 117):

"I would most strongly urge this course (early exploration of the kidney) with a twofold object: (1) to clear up the case, and (2) to perform nephrectomy if the kidney is found to be the site of so fatal a disease. If I am told of the unwisdom of this step, owing to the probability of both kidneys being affected, I would reply that, as a rule, both kidneys are not affected at an early stage. Thus Dr. Fagge (*Medicine*, vol. ii. p. 488) gives a list of thirteen cases which show 'the characters of tuberculous disease of the kidney at its commencement.' In only three of these were both kidneys affected, and in all these tubercular mischief was present in the bladder also. If during this early exploration one or two pyelitic dilatations are found, extirpation of the kidney should be performed while the organ is still small and movable, and before the rest of the genito-urinary tract becomes involved.

"I need not remind my hearers of the miseries which lie before a patient with established tubercular kidney, the results of ulceration of his bladder, with, perhaps, vomicæ in his prostate, and the inevitable course downhill—arrested, it may be, for a little while by nephrotomy and drainage."

My own experience of drainage alone in established tubercular kidney is most unfavourable, the relief being slight and short-lived, and not arresting long the hectic and increasing debility. On the other hand, in four cases in which I have been able to perform nephrectomy early (cases Nos. 8, 12, 13, 16, p. 159) the result has been most satisfactory. In four others (3, 4, 11, 17, *ibid.*), the recovery, though less complete, was very satisfactory. Finally, in two (cases 15 and 22, *ibid.*), the eleventh and twelfth cases in which I have removed a tubercular kidney, the disease was too advanced in both for the result to be satisfactory.

Ramsay (*loc. cit.*, p. 113) gives the results of 191 cases of primary nephrectomy for renal tuberculosis. Of these 106 were noted as cured, 31 were improved, 37 died within one month of the operation, and 17 died at a later period.

Forty-nine cases of secondary nephrectomy after a previous nephrotomy are also given. Of these 18 died shortly after the operation, and 23, or 46 per cent., were cured. Of the 37 deaths resulting from primary nephrectomy, 9 were due to uræmia, 3 to tuberculosis of the other kidney, and 2 to amyloid degeneration of the other kidney. These 14 deaths serve to emphasise the importance of thorough investigation of the capacity of the other kidney before nephrectomy is decided upon. For although the second kidney, as mentioned above, is not often affected in early cases, yet when the case only comes under observation in the more advanced stages, it will very possibly be diseased.

Should the condition of the other kidney still remain doubtful after the ordinary methods of investigation have been exhausted, then it becomes necessary to examine it by means of an exploratory incision. Edebohls (*Annals of Surgery*, April 1898) advises a lumbar exploration, and this is doubtless the safer and more certain method. The disturbance caused will be comparatively slight, and is more than balanced by the additional security that the surgeon will feel when proceeding to perform nephrectomy a week later. The doubtful utility of examination of the other kidney through an abdominal incision has been referred to above (p. 135). These remarks apply equally to the two following conditions, calculous disease and hydro-nephrosis.

ii. Calculous pyelitis or pyo-nephrosis where the kidney is destroyed by long formation of calculi and consequent suppuration, where numerous calculi exist with sacculation of the kidney, or where a large and branching calculus is so embedded as to resist removal. These indications for nephrectomy have been already considered under the heading Nephro-lithotomy (p. 130), as it is during the performance of this operation that the question of removing the kidney for the above conditions will arise.

iii. A kidney the site of hydro-nephrosis. The treatment here will vary according to the degree to which the disease has advanced. Aspiration, lumbar nephrotomy, and drainage, the edges of the cyst being stitched in the wound, and nephrectomy have, each, been advocated here. Occasionally repeated aspirations are sufficient, as in Mr. Croft's case (*Clin. Soc. Trans.*, vol. xiv. p. 107), in which eight aspirations (through the lumbar region) within four months, between three and four pints being withdrawn each time, sufficed to cure a hydro-nephrosis in a boy aged 12. It is noteworthy that the case was distinctly traumatic in origin, and that the last fluid withdrawn contained a very large amount of albumen. It is for such cases, especially if the interval between the aspirations lengthens each time, that aspiration should be reserved. This method is, however, so rarely successful that the surgeon will, in advanced cases, have to decide between nephrotomy and drainage, and nephrectomy. It is now acknowledged by the advocates of the former step that it has given less favourable results than were expected. The time taken is usually very great, the frequent change of dressing necessitated by the constant soakage is most irksome, and, later, the wearing of a lumbar urinal is most inconvenient, leading as it often does to an eczematous, raw area around the sinus. The sinus, moreover, is liable to become foul and to contain phosphatic material. The tube also, which leads into the urinal from the sinus, easily becomes blocked, and causes much discomfort from redistension of the cyst.

In future, nephrectomy will be oftener performed for hydro-nephrosis where the kidney is much altered, either as a primary operation or after allowing a sufficient interval to elapse for shrinking of a large cyst, but no prolonged delay. Where, therefore, the patients are young, with every prospect of a long and active life before them, where a month's drainage has failed to bring about any considerable diminution in the amount escaping, and where the fluid thus coming away contains but a small amount of urine, and where there is evidence that the other kidney is competent, the cyst and remaining kidney tissue should be extirpated from the loin before it has become more firmly matted to the surrounding parts.*

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* If in hydro-nephrosis, after an exploratory nephrotomy, bloody urine descends into the bladder, the indication for leaving the kidney will be greater, especially if the viscus show a cortex of fair thickness, and is not a mere sac with little if any secreting tissue.

In cases where the hydro-nephrosis is early and due to movable kidney, nephrorraphy will often suffice (p. 162). In a few other cases the hydro-nephrosis may be due to valve or stricture of the ureter. For an account of the different operations performed for the relief of these conditions, I may refer my reader to the surgery of the ureter (p. 167).

iv. Certain cases of malignant disease. These fall into two groups, which must be looked at separately from an operative point of view. One group, the *sarcomata*, occurs in children before ten, usually much earlier, before five. In such cases the risks of immediate death from shock, aided often by peritonitis, of early recurrence, or of death from secondary deposits elsewhere, should be put clearly before the parents, together with the certainty of an early death if the growth is left.

The other group, the *carcinomata*, occurs usually in patients past middle age.

In either case, an operation should only be performed in an early stage, while the growth is still internal to the capsule, and while the strength, health, and condition of the viscera are satisfactory. On the other hand, where the history makes it probable that the growth has got beyond the earlier stage, when there is any extension to the lumbar glands or other viscera, when there is nausea, emaciation, or a temperature inclined to fall, the time for operation has gone by. So, too, any ascites or œdema of the lower limb are absolute contra-indications.

With regard to the frequency of secondary deposits, the fact that Dr. Dickinson* found these to be present in no fewer than 15 out of 19 cases strengthens, very decisively, the argument in favour of early operations while these growths are small, at which time, moreover, they can be successfully attacked through a lumbar incision sufficiently enlarged by the steps given at p. 148, or by one made anteriorly.

Much information may be gained from a very complete study of sarcoma of the kidney in children by Mr. George Walker, of Baltimore (*Annals of Surgery*, vol. ii. 1897, p. 529 *et seq.*). In all, 74 cases in which nephrectomy was performed are here collected. Of these 27 died from the effects of the operation, 28 died from recurrence, 14 passed out of sight, and 4 remained well from three to five years after the operation. The immediate mortality is therefore 36·4 per cent. Though still very high, this is a vast improvement on the earlier published figures; for instance, Butlin (*Oper. Surg. of Malig. Disease*, p. 254) gives 60 per cent. As regards cures, 4 cases, or 5·4 per cent., may be considered as probable cures, but it is quite possible that some of the 14 cases that passed out of sight were cured, since they were all of them well when last heard of; in this case, 5·4 per cent. is too low. Briefly, the most important points in connection with these four successful cases are as follows:—

1. *Israel's case.* Boy aged 14 years. The tumour, about double the size of a man's fist, was removed through a T-shaped lumbar incision. The peri-renal fatty tissue was freely excised after removal of the growth. Well five years later.

2. *Schmidt's case.* Girl aged 6 months. The tumour was the size of a child's head, and was removed through an incision two fingers' breadth to the left of the middle line of the abdomen. The peritonæum was not sutured. The child was well four years later.

3. *Abbe's case.* Girl aged 2 years. The tumour, which weighed 2½ lbs., was removed

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* *Dis. of the Kidney and Urinary Derangements.*

through a transverse incision extending from the lumbar region to near the middle line of the abdomen. The child was well four years after.

4. *Abbe's case.* Girl 14 months old. A transverse incision was again used, extending from the middle line of the abdomen to within 6 cm. of the spine. The child weighed 15 lbs., the tumour 7½ lbs. The child was well three and a half years later.

Mr. Walker also compares the length of life, from the time of the discovery of the tumour, in cases not operated on with those that were operated on. In 68 cases not operated on the average length of life was 8·08 months, in the operation cases the average was 16·77 months, an average gain, that is, of 8·69 months by operation. Another successful case is described by Malcolm (*Clin. Soc. Trans.*, vols. xxvii. and xxviii.), the child being in good health two years and four months after the operation.

Since this disease, when left to itself, is necessarily always fatal, a rate of cure after operation of at least 5 per cent. constitutes very strong evidence in favour of operation wherever there is a reasonable hope that the whole of the disease can be removed.

With earlier diagnosis and improved technique, it is to be hoped that a still greater measure of success will obtain.

To secure this improvement the following points deserve attention. An exploratory incision should be made as soon as obstinate pain and swelling (perhaps revealed by an anæsthetic) call attention to the possibility of a growth, and before time has elapsed for lymphatic infection. Where the case comes before the surgeon in a more advanced stage, he should bear Mr. Malcolm's advice in mind. As in the "treatment of new growths elsewhere, the more definite the outline of the tumour, the more mobile it is, the slower its growth, the better the state of the patient's health—in fact, the stronger the evidence that the patient is only locally affected, the more likely is operative treatment to be followed by prolonged immunity from disease." Cases may be observed, on the other hand, in which the tumour has no definite outline, being fixed to and incorporated with the neighbouring structures, so as to be absolutely immobile, being also of very rapid growth and accompanied by extreme emaciation. Such cases are obviously unsuitable for surgical interference. "Before the operation every precaution should be taken against shock. Thus the limbs should previously be bandaged in cotton wool, the site of the wound only exposed, the head kept low, injections of brandy and strychnine should be ready, ether administered, warmth maintained by operating on a hot-water table when possible, and warm irrigating fluid used. Finally, an assistant should always be at hand to perform saline infusion, and this, if used, should be resorted to before the close of the operation, when the condition of shock may be irremediable."*

During the operation itself the incision must be sufficiently free. The lumbar one, carried very freely forward† (p. 148), will give sufficient room. The peritonæum will only be opened when the growth is very large or adherent. Where grave shock is imminent, hæmorrhage may be controlled by forceps left *in situ* for thirty-six or forty-eight hours. It is easy to prevent a child from rolling on to these by packing the patient firmly on either side with pillows in a cot. Finally, as Mr. Malcolm has shown, every vestige of the capsule, and all fat adjacent to it, together with any fat or glands about the renal vessels, should be removed.

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* Dr. Abbe strongly advises the use of the Trendelenberg's position as emptying the blood from the growth into more important parts, and the injection of strong coffee and brandy into the rectum after the operation.

† Dr. Abbe used a similar one in his two successful cases mentioned above.

v. Certain cases of injury. These are very rare, and fall into the following groups: (*a*) Where an injured kidney protrudes from a wound of the abdomen, usually the loin. (*b*) In some cases of non-penetrating wound of the kidney, as when it is ruptured from a fall or blow. (1) Where hæmaturia does not yield to treatment,* the bleeding being well marked, or latent and insidious, giving evidence indirectly of its existence by the increasing pallor, the failing pulse, impending syncope, and perhaps a swelling in the loin, as in case No. 20, Table, p. 161. (2) Later on, when the injured kidney is setting up serious suppuration, which does not yield to drainage. (3) For ruptured ureter and traumatic hydronephrosis: Mr. Barker has recorded (*Lancet*, Jan. 17, 1885) a most successful case, in which, after other treatment had failed, he removed a kidney three months after the rupture.

The child, aged 3½, had been run over, but beyond some bruising and one small clot passed there was nothing to point to injury of the urinary tract. Having left the hospital in a fortnight, apparently convalescent, he was, a few days later, admitted with a fluctuating swelling in the right loin. This increasing, was aspirated, the fluid yielding ½ per cent. of urea. The swelling was subsequently drained, and the drainage-tube becoming blocked with phosphatic deposits, and thus causing a good deal of constitutional disturbance, the kidney was removed. It proved to be healthy, the ureter being torn across just below it.

(*c*) Penetrating wounds. Very rarely indeed nephrectomy may be called for here (1) when hæmorrhage does not yield to treatment aided by exploration and plugging; (2) when a urinary fistula persists after such a wound in certain cases—*e.g.*, when the other kidney is healthy. (*d*) Gunshot wounds. Owing to the increase of revolver-injuries and recent advances in abdominal surgery, this matter has lately received much attention.† Whether in civil or military practice, gunshot wounds of the kidney are only too likely to be complicated with injuries of the intestines, liver, and spine. When, in the course of an exploratory operation in the case of a gunshot wound of the abdomen, the kidney is found to be the seat of hæmorrhage, if uncontrollable by other means, nephrectomy should be performed.

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* In Mr. Rawdon's case (*loc. infra cit.*) nephrectomy was performed for hæmorrhage after an injury, but at rather a later date—*e.g.*, on the seventeenth day after the fall—to prevent blood from entering the bladder and increasing the acute cystitis present. Here the hæmaturia had diminished at first, and subsequently increased.

† As might be expected, American surgeons have not been slow to avail themselves of their opportunities. Prof. Nancrede (*Annals of Surgery*, June 1887, p. 480) suggests that where the renal or splenic artery is cut by a bullet the viscus should be removed, as gangrene is inevitable. Dr. Parkes (*loc. supra cit.*, Nov. 1887, p. 379), in a case of bullet-wound of the abdomen, having sewn up five perforations of the intestine, found that the left kidney was perforated. The hæmorrhage was very slight at this time. After doing well for twenty-four hours, the patient began suddenly to fail, and died, collapsed, from hæmorrhage from the kidney. Dr. Parkes regretted that he had not performed nephrectomy. Dr. C. Briddon, of New York (*Annals of Surgery*, 1894, vol. i. p. 641), in three cases explored an injury to the kidney by a lumbar incision at a date varying from one to four weeks after the accident, and by evacuating bloody urine, fœtid clots, irrigating, and tamponnading with iodoform gauze, saved his patients from a state of grave peril.

vi. In a very few cases of movable kidney. Where nephrorraphy has been properly performed. as *e.g.*, by the method given at p. 165, nephrectomy will never be required. In a few cases nephrorraphy will fail, owing to the complication of organic disease, as in the instances given at p. 163.

vii. For a few rare diseases of the ureter. Israel's case (quoted at p. 120) of chronic ureteritis, for which nephrectomy was performed, may be again referred to here. Another very instructive case, one of ureteral papillomata, is described by Le Dentu and Albarran (*Bull. de l'Acad. de Méd.*, No. 9, 1899):

> Male, 33, had had frequent attacks of renal colic for which nephrotomy had been performed without benefit. A diagnosis of ureteral papilloma was arrived at by means of the cystoscope. The kidney and ureter were therefore removed. The kidney was hydronephrotic, and the ureter contained two papillomata, one three-quarters of an inch below the renal pelvis, the other at the vesical orifice.

viii. Hydatid disease of the kidney. Jerosch (*Centralbl. f. Chir.*, No. 38, 1899) has recently recorded two cases of nephrectomy for this rare condition. In the first case, death took place on the third day from exhaustion; the second case recovered.

ix. Aneurysm of the renal artery. Prof. W. W. Keen (*Philad. Med. Journ.*, May 5, 1900) reports a successful case of nephrectomy for this rare form of aneurysm:

> The patient was a lady, aged 45, who had suffered for about five years from severe attacks which began with chilly sensations, followed by nausea and considerable rises of temperature. These attacks lasted a variable time and were thought to be "bilious." Once only, during the last attack, there was a small amount of blood in the urine. A large tumour, thought to be probably a hydronephrosis, was found occupying the whole right ilio-costal space, and extending from the right flank to a point about 5 cm. beyond the middle line. The tumour, which was removed without great difficulty, was found to consist of the kidney flattened out on the surface of a large aneurysm of a branch of the right renal artery.

Prof. Keen gives abstracts of twelve similar cases, two of which were operated on. Recovery took place in both these. Prof. Keen remarks that "there is nothing peculiar about any of the three operations other than the danger of hæmorrhage, especially from the pedicle. In my own case the pedicle was broader than I have ever encountered in any prior case of nephrectomy, so that I had to tie it in seven different sections. All three of the operative cases have terminated in recovery, a most encouraging outlook for the future."

Operations.

These are: A. **Through the Lumbar Region.** B. **Through the Abdominal Wall, and the Peritonæum as well**—(*a*) by an incision at the outer edge of the rectus; (*b*) by one in the linea alba. C. **Through the Abdominal Wall, without opening the Peritonæum.** These methods are compared at p. 156. D. **A Combination of the Abdominal and Lumbar Incisions.** E. **Knowsley Thornton's Combined Method.**

A. Lumbar Nephrectomy.

Operation.

The position* of the patient and the earlier steps are much as those already given in the account of Nephro-lithotomy, p. 123.

When the lumbar fascia has been slit up and the fat around the kidney torn through, this organ should be well thrust up by an assistant making careful, steady pressure with his fist against the abdominal wall; the wound being now widely dilated with retractors, the surgeon examines the kidney, and has next to decide on three points:

(1) Is removal required?† (2) Will more room be wanted? If so, the incision already made, slightly oblique and about half an inch below the twelfth rib, should either be converted into a T-shaped one by another made downwards from its centre, or at its posterior extremity, along the outer edge of the quadratus lumborum, or continued downwards and forwards, as described under Nephro-lithotomy (*vide* p. 124). Additional room may also be gained by an assistant slipping his fingers under the lower ribs and drawing them forcibly upwards. (3) Is the kidney firmly matted down or no? If there has been no surrounding inflammation, the extra-peritonæal fat, the peritonæum, and colon will be readily separated by the finger working close to the kidney until the pelvis and vessels are reached. But if inflammation has caused firm adhesion and matting down of the kidney to adjacent parts, the altered fat and thickened and adherent capsule must be divided down to the kidney itself, and this gradually enucleated (partly with the finger, partly with a probe-pointed bistoury) from out of its capsule, which is left behind.

The only guide in such a case is the tissue of the kidney itself, close to which the finger and knife must be kept.

A case of Mr. H. Marsh's well shows this difficulty:

Removal of the kidney could not here be effected, owing to its size and the firmness with which it was embedded in the surrounding condensed areolar tissue. That part of the kidney which had been exposed was accordingly transfixed with a strong double ligature, and cut away. Complete suppression of urine followed the operation, and the patient died in about thirty hours. At the post-mortem examination the remaining part of the right kidney and its ureter were found to be so firmly embedded in dense cicatricial material that they were dissected out only with difficulty. The kidney itself was converted into numerous sacculi, in the walls of which, however, some remains of renal structure could still be traced. The opposite kidney weighed 6 oz. Its capsule was adherent, and there were two or three cysts on its surface. On section, its structure looked somewhat confused and cloudy, but its condition was not such as to indicate advanced disease.

Mr. Greig Smith stated (*Abdom. Surg.*, p. 508) that, in cases of old-standing suppuration with great enlargement, the vena cava and the aorta may be intimately adherent to the capsule. "One such case was met with in the post-mortem room of the Bristol Infirmary; here it was simply impossible, after death, to dissect apart the venous wall and the renal capsule. In another case, for similar reasons, the organ could not have been removed by any proceeding claiming to be recognised as surgical."*

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* Additional care should be taken to open out the space between the last rib and the crest of the ilium by the arrangement of pillows underneath the loin; the precautions given to avoid shock (p. 144) must also be taken here.

† This question has already been alluded to in the case of a strumous kidney incised and drained (p. 140); in that of a kidney much damaged by one or more calculi, under the subject of Nephro-lithotomy (p. 130); and in the case of hydrone[illegible] p. 142).

If further room is still required, this may be easily and effectually gained by making use of additional incisions as recommended by Prof. König, of Göttingen (*Cent. f. Chir.*, 1886, Hft. 35; *Ann. of Surg.*, Nov. 1886, p. 445). This surgeon, having found great difficulty in getting free access to the kidney by the ordinary lumbar incision, cuts through the soft parts vertically downwards along the border of the erector spinæ to just above the iliac crest. He then curves the incision towards the navel, and ends at about the outer border of the rectus, if necessary going through this muscle to the umbilicus. It may be often advisable to make the perpendicular cut oblique, running in a flat curve into the umbilical part. All the muscles are incised quite down to the peritonæum. This method gives a surprisingly free entrance, but it can be much improved by introducing the hand through the perpendicular part of the cut, separating the peritonæum in front and pushing it forwards. Prof. König proposes to call this the retro-peritonæal lumbo-abdominal incision. If sufficient space is not thus afforded, or if, for diagnostic or operative purposes, it is desirable to approach the tumour from the abdominal cavity, the peritonæum can be divided in the transverse cut. If infective material is to be removed, this peritonæal opening must be carefully looked after.

Very large kidneys and renal tumours can be got out through very free lumbar incisions. I may state here that I twice, in 1890, removed kidneys eight inches long through the very limited ilio-costal space of little children aged respectively 3 and 3½. One was a case of sarcoma, the other of cystic kidney. Both made excellent recoveries; but as, in the former, the renal vein was thrombosed with growth, it was clear that a few months would see the end. In each case the lumbar incision was carried forward very freely, and the long axis of the tumour brought out in that of the wound.

In both Abbe's successful cases of sarcoma (*vide supra*, p. 143) long transverse lumbar incisions were found to give ample room, in the second case the tumour weighing 7½ lb. in a child only 14 months old. Many other cases might be quoted.

The danger of ventral hernia is guarded against by using deep sutures, by allowing only gentle movements at first when the patient gets up, and by the use of a support. By these means the risk of hernia may be reduced to a minimum.†

When the kidney has been sufficiently enucleated either out of its capsule, or, together with this, out of the peri-renal fat, the vessels and ureter must be dealt with. The latter should be taken first, as this step, especially if the ureter be enlarged, will facilitate dealing with the vessels.

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* As will be seen from Case 22 in the table at p. 161, in which I injured the vena cava in the case of a large tubercular kidney, very adherent; the most difficult case I have met with. In a case of attempted nephrectomy (*Amer. Journ. Med. Sci.*, 1882, vol. ii. p. 116) the removal of the organ was rendered impossible, not only by its adhesions to the tissues around, but also, as was proved post mortem, to the colon and pancreas as well.

† It is noteworthy that Prof. Bergmann, of Berlin, whose name is well known in connection with the surgery of the urinary organs, advocated the lumbar operation for the removal of malignant growths of the kidney (*Annals of Surgery*, Sept. 1886, p. 256).

If the ureter is dilated, and contains foul pus or tubercular matter, it should be divided as low down as possible, and the stump carefully cleaned out with a sharp spoon and dusted with iodoform, or fixed in the wound with a suture, for fear of its causing infection.

The vessels are then tied in at least two bundles with sufficiently stout carbolised silk, or chromic gut. This is passed, with an aneurysm-needle of sufficient length and suitable curve, through the centre of the bundle, each half of which is tied separately, and finally one of the ligatures is thrown round both halves together. In passing the ligatures, they should be pushed well in towards the spine, so as to leave ample room between them and the kidney to prevent all risk of their slipping. If the kidney can be raised out of the wound, passing the ligature is much simplified. If this is impossible, the surgeon may find help by having the lower ribs well pulled up by an assistant, while another keeps the kidney well up by pressure against the abdominal walls, light being also thrown in, in case of need, by a forehead mirror or electric lamp. While the ligatures are being tied and the pedicle divided, no tension should be put upon the vessels.

As soon as the ligatures are secured in position, the pedicle is snipped through at a safe distance from them with blunt-pointed scissors. If the pelvis of the kidney contains foul or tubercular pus, and if there is room, a large pair of Spencer Wells's forceps should be put on the ureter, and the pedicle cut through between this and the ligatures, so as to prevent the escape of septic material. If any hæmorrhage now takes place, it is probably due to some vessel* not being included, or to an artery having slipped through the knot owing to the parts being stretched at the moment of ligature. The bleeding point, to which the ligatures will act as guides, is now secured with forceps and ligatured. The ligatures are then cut short

When a pedicle presents especial difficulties from its shortness, thickness, and the way in which it is overlapped by the kidney, a preliminary ligature should be applied and the kidney cut away well in front of it,† a step which will give access to the vessels and ureter; a double ligature is then applied behind the temporary ligature, which is now removed. Again, where the pedicle is very short, a portion of kidney may be left to

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* The late Mr. Greig Smith (*loc. supra cit.*) gave the following practical hints as to the vessels:—The veins are a good deal larger than the arteries and overlap them. At the hilum the veins branch quite as much as the arteries—*i.e.*, four or five times—and the subdivision extends farther towards the middle line. It is very frequent for two or more trunks to represent the renal vein, and sometimes surround the artery. The want of uniformity in the renal vessels is against the possibility of ligaturing the artery and vein separately. In many cases this will be found impossible; in none is it necessary. Indeed, the walls of the veins, by acting as a sort of padding, may add to the safety of ligatures, preventing the thread from slipping. Mr. Greig Smith further states that the only deaths as yet recorded from secondary hæmorrhage were in two cases where the vessels were separately tied.

ange (New York Surg. Soc., Nov. 22, 1886; *Annals of Surgery*, April 1887) hat in a case in which he adopted this course no sloughing took place, as ensure the ligature retaining a safe hold. I was obliged to adopt this course in a case of nephrectomy for calculous pyelitis in which I had removed twelve stones a year before (case No. 7, Table, p. 159). A sinus persisted, which became abominably septic. As the stump of the kidney was fœtid, I inserted no sutures, and packed the wound with strips of sal alembroth gauze wrung out of turpentine. The patient made a good recovery.

A modification of the method of leaving a portion of the kidney to form the pedicle may be made use of in cases of kidneys of large size which cannot be brought through the wound. In such cases, the vessels having been secured by a temporary ligature or by Spencer Wells's forceps, the kidney should be cut away in separate portions, thus doing away with the struggle required in bringing out a large kidney and the risks of producing serious shock by pulling on the vessels.*

Another means of treating the pedicle, where this is short and matted down, is to cut it through piece by piece, securing each bleeding point with compression forceps, and tying them off one by one. Or the vessels may be under-run, as in excision of the knee, but on a larger scale and more *en masse*.

By such methods as the above the risk of wounding the cava or aorta is avoided. If the amount of kidney left is small, it will no doubt atrophy and give no further trouble, but, if large, some sloughing will probably take place; in such a case, iodoform or glutol should be dusted on to the stump and free drainage provided.

Another difficulty which may be present now is caused by the kidney having contracted adhesions to the peritonæum and some of its contents.

I have three times opened the peritonæum, when using the lumbar incision. To one case, a nephro-lithotomy, I have alluded at p. 128; the other two were cases of growth and tubercular pyelitis, for which I was removing the kidney. All three cases recovered. The opening, in the two latter cases a small one, was at once covered by an aseptic sponge, and sutured with fine chromic gut.

Where it is certain that septic fluid from the kidney has entered a wound in the peritonæum, the surgeon should, after the operation is completed, make a small opening in the lower part of the linea alba, wash out the peritonæal cavity with boiled water, and place a drainage-tube in Douglas's pouch, this being regularly emptied as often as is

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the thick, fleshy part of the pedicle beyond the ligatures was gradually absorbed by the healthy granulations of the wound, which remained aseptic. Dr. Leopold (*Arch. für Gynäk.*, xix. 1), in a case of nephrectomy, tied the pedicle in three, and left a triangular portion of the kidney parenchyma, in order to prevent hæmorrhage. The patient made a good recovery.

* The question of how far serious shock may be induced by tightening ligatures on parts in such intimate relation with the abdominal sympathetic centres is one of great importance and needs further investigation. According to Mr. Barker (*Dict. of Surg.*, vol. ii. p. 49), who has taken the trouble to have the pulse watched carefully at this stage of the operation, it is not much affected to the touch, but a sphygmographic tracing taken in one case showed some irregularity during the necessary handling of the kidney, and increased arterial tension when the pedicle was ligatured. In my own experience, any alterations in the pulse are occasional only, and quite inconstant. Dragging on the pedicle is much more likely to produce shock.

requisite. Mr. Page, of Newcastle, adopted this plan in two cases, with entire success (*Lancet*, vol. i. 1893, p. 999).

The question may arise as to what is to be done if hæmorrhage still persists after the kidney is got out and its pedicle tied. Very few cases will occur in which ligatures cannot be applied to each bleeding point if the wound be well opened up, carefully dried, and if light be thrown down to the bottom. But when bleeding still goes on, Spencer Wells's forceps must be applied to the bleeding point and left *in situ* for two or three days, during which time they will also help to drain the wound. I have used this method twice with good results. If the forceps will not hold, careful plugging must be resorted to, strips of iodoform or sal alembroth gauze wrung out of carbolic acid lotion 1 in 20, the deepest attached to silk, and systematically packed into the bottom of the wound around a large drainage-tube till the wound is thoroughly filled; an external gauze dressing is then applied, and over this a firm but elastic padding of sal alembroth wool, which is kept *in situ* by firm bandaging. Mr. Clement Lucas (*Trans. Intern. Med. Congr.*, vol. ii. p. 271) nearly lost, from secondary hæmorrhage, a case in which nephrectomy had been successfully performed for suppurating strumous pyelitis. The bleeding came on about the fifteenth day, probably from the ligatures, which had been left long, being dragged upon. The hæmorrhage again occurred on the sixteenth day, when an attempt was made, after opening up the wound, to slip a ligature along the old ones, and thus to re-tie the pedicle. Hæmorrhage again occurring on the seventeenth day, and the patient being in a most precarious state, the wound was tightly and forcibly plugged with two large sponges steeped in perchloride of iron, and the abdomen bound firmly round with a flannel bandage. Morphia was given subcutaneously. About a week later the removal of the sponges, by cutting away the protruding part, was commenced, and this was completed by the end of another week. No bleeding recurred after the plugging, and the patient made a good recovery.

When all bleeding is stopped, a large drainage-tube should be inserted, with one end carried down to the very bottom of the wound, and the other cut almost flush with the surface. The wound is then partially closed with salmon gut and carbolised-silk sutures, some iodoform dusted in, and aseptic dressings applied. If there has been much difficulty in getting out the kidney—and in cases of old inflammation it has to be dug out by touch, with very little help from sight—as in case No. 2, Table, p. 159—no sutures should be used, the wound being merely lightly plugged with iodoform gauze wrung out of carbolic acid lotion 1 in 20.

Dr. Weir, of New York (*Ann. of Surg.*, April 1885, p. 311), during a nephrectomy in a young woman the subject of pyonephrosis, met with very severe hæmorrhage after ligature of the pedicle. This had apparently been effected with a single ligature. After removing the kidney, a gush of venous blood ensued, which was only partly arrested after repeated seizures with long pressure-forceps, but was finally controlled by stuffing the wound full of sponges and turning the patient on her back. The shock was profound, and all the measures to produce reaction were resorted to. Transfusion performed twice to a total amount of 22 oz. gave rise at first to great improvement, but the patient died ten hours after the operation. The necropsy showed that the hæmorrhage came from a vein of considerable size, 1·5 centimetre above those secured by the ligature and forceps.

B. Nephrectomy by Abdominal Incision through the Peritonæum.

a. **By Langenbüch's Incision at the Outer Edge of the Rectus.**

b. **By an Incision in the Linea Alba.**

These two methods may be taken together. The former is the one most usually employed, as it has the following great advantages:—

1. The incision is nearer the vessels and ureter. 2. There is much less general exposure of the peritonæal sac (Knowsley Thornton). 3. The kidney is reached through the outer or posterior layer of the meso-colon, a step which avoids (*a*) hæmorrhage and (*b*) the risk of sloughing of the colon, as it is the inner or anterior layer—that between the colon and the middle line—which contains most of the vessels to the colon, and is especially rich in veins. It is this layer which is divided in the incision through the linea alba. 4. The operation can be rendered largely extra-peritonæal by having the inner edge of the cut meso-colon and that of the parietal peritonæum held in apposition or sutured with catgut.

Both operations give good room for necessary manipulations, both afford an opportunity for examining with the hand the condition of the opposite kidney.* After both, the wound can be drained posteriorly from the loin, but more easily after Langenbüch's incision.

a. **Langenbüch's Incision.** — The abdominal wall having been cleansed, an incision is made, at least four inches long at first, commencing just below the ribs, in the line of the linea semilunaris on the side of the disease, the centre of the incision being usually opposite to the umbilicus. The skin, subcutaneous tissue, and the aponeuroses at the outer edge of the rectus having been divided down to the transversalis fascia, and all hæmorrhage† having been carefully arrested, the transversalis fascia and the peritonæum are pinched up together, punctured, and slit up on a finger used as a director, the hand is introduced, and the size of the growth and the condition of the opposite kidney investigated. In the case of a large growth the incision will now be enlarged, and any further hæmorrhage arrested. The growth, if large, is usually now seen in part. Any presenting intestine is turned over to the opposite side, and kept out of the way with a pad of aseptic gauze. The outer or posterior layer of the meso-colon will now probably present itself, pushed forward by the growth, which is often bluish-white in appearance and covered by large veins. The above-mentioned layer of the meso-colon is next torn through, either in a vertical or transverse direction, as will best avoid the vessels exposed. Any bleeding should be at once arrested by Spencer Wells's forceps and ligatures of fine silk. The intestines are then packed away with sterile gauze.

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* I cannot but think that this advantage of the incisions through the peritonæum has been made too much of. In Mr. Barker's words (*Dict. of Surg.*, vol. ii. p. 48), "Though the hand may reach the kidney opposite to the one it is proposed to excise, its soundness or the reverse cannot be ascertained by mere palpation. Great enlargement, or, on the other hand, great reduction, in size, or complete absence, might be detected; but the organ might be tubercular, or fibroid, or contain a moderate-sized calculus, and yet the hand be unable to detect the condition." I have also referred to this matter, p. 135.

† The amount of this, as will be familiar to all surgeons who have opened the peritonæal sac by this incision for intestinal obstruction, &c., varies a good deal. In the case of growth, large vessels are often present in the peritonæum over the kidney.

A sufficient opening having been made in the outer layer of the meso-colon, the fingers are introduced to examine into and further separate the connections of the kidney.

During all the necessary manipulations in the case of a growth, the greatest possible gentleness must be used so as not to rupture the capsule. In rapidly growing sarcomata, especially in children, the consistency may be jelly- or glue-like, and thus, if the capsule is opened, portions of the growth may readily be left behind. Again, hæmorrhage may easily follow this accident, and prove most embarrassing.* If the bleeding is of the nature of troublesome oozing it may be met by packing the cavity with iodoform gauze, the ends of which are brought out through a counter-incision in the loin. The wound in the peritonæum is next carefully sutured over the gauze, thus shutting off the abdominal cavity. The gauze may be removed in forty-eight hours (F. Page, *Lancet*, vol. ii. 1893, p. 1188). If the bleeding is from one or two points which cannot be tied, Spencer Wells's forceps may be left *in situ*, and removed in forty-eight hours.

The same precautions as to not damaging the capsule should be taken in the case of a kidney full of fluid. Where there is any risk of such fluid or of soft growth escaping into the peritonæal sac, sterile gauze should be carefully packed around, or the cut edges of the meso-colon and the parietal peritonæum united.

If the parts about the pedicle are free from adhesions, the vessels may be tied before the kidney is enucleated, which will render this latter step bloodless. Wherever it is possible, forceps should be placed on the vessels close to the kidney before they are divided, to save spilling of blood from the kidney; and where this contains pus, the same precaution should be taken with the ureter.

The vessels should be tied with the precautions given above (p. 149). All dragging on the pedicle should be scrupulously avoided.

The kidney being removed, the site of the operation is most carefully cleansed and dried. If troublesome oozing has occurred and is at all likely to persist, a large drainage-tube had best be passed out through the loin by pushing a short pair of dressing-forceps from the site of the kidney so that it bulges in the loin, where it is cut down upon, and used to seize the tube. Another way of draining is by Keith's tube through the abdominal incision, sucked out regularly. Both this and lumbar drainage should be employed in complicated cases. It has been suggested that the divided edges of the meso-colon may be united with a few points of catgut suture, but this precaution does not seem to be absolutely needful, as the edges usually fall readily into apposition.

Mr. Knowsley Thornton lays stress upon his method of treating the ureter. This tube is taken last in the enucleation of the kidney, "and, before separation, its renal end should be secured by pressure-forceps, then a ligature tied a little way from the forceps, and a sponge placed under it before it is divided. Whenever it is possible, I enucleate it for some distance from the kidney before dividing it, so that its cut end, with the sponge under it, may be at once drawn outside the abdomen; and afterwards fix it in the lower angle, or most convenient part of the abdominal incision, with a cleansed safety-pin. I regard this fixing out of the stump of the ureter as the most important detail in the operation, and in every case in which I have been obliged to cut it off deep in the wound I have had distinct evidence of suppuration and trouble around it." Mr. Thornton considers the objection that this method risks the occurrence of future intestinal obstruction an entirely fanciful one. At the worst, a ureter so treated is only a slight ridge over a small surface of the abdominal wall, quickly disappearing by atrophy. Other surgeons, who have treated the ureter by ligature and dropping it in, have not met with the results of suppuration and sloughing which Mr. Thornton thinks are very likely to follow on this course. The only after-trouble which I have known the ureter to give is in cases of removal of tubercular kidney. Unless this operation is performed at a very early stage, there must always be a great risk that, owing to the ureter having become involved, the mischief will spread to the bladder.

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* Thus it has even happened to Prof. Czerny, whose experience in nephrectomy is almost unrivalled, to be driven to tie the abdominal aorta. The profuse hæmorrhage met with in removing a large growth of the left kidney could only be stopped by pressure on the abdominal aorta. This vessel was accordingly tied. Death took place ten hours later. It was found that the renal artery had been torn through at its entrance into the tumour. The ligature on the aorta had been so placed that, while the blood-supply through the left was cut off, the right vessel was pervious.

Ramsay (*loc. supra cit.*) discusses the mode of dealing with the ureter in tuberculous cases at some length, and quotes Regnier as having removed a tuberculous ureter some months after the nephrectomy. Kelly, in the *Johns Hopkins Bulletin*, March 1896, reports three cases in which he removed the whole of the tuberculous ureter with success at the time of the nephrectomy. On the other hand, there is evidence to show that tuberculous disease of the ureter tends to undergo a process of cure after nephrectomy. One case in point is that of Tilden Brown (*Annals of Surgery*, 1899, vol. i. p. 755). Here the kidney was removed and the ureter left behind. At the necropsy, some months later, the ureter, previously as thick as the thumb, had diminished to one-fourth its size.

Ramsay's conclusions on this point are as follows: "It is safest to remove the ureter with the kidney, as a persistent fistula may give trouble if it is allowed to remain in the body;" and again, "that a certain proportion of these fistulæ will finally disappear, either after the removal of a deep suture, or because of the slow disappearance of the tubercular disease in the ureter, which, in these cases, gradually changes into a fibrous cord."

b. **Nephrectomy by an Incision in the Linea Alba.**—For reasons already given, p. 152, this method is not recommended, that of Langenbüch, already fully described, being preferable.

The incision in the linea alba will not materially differ from that for ovariotomy or abdominal exploration, and the same precautions are called for in removing a kidney by this method as in that through the linea semilunaris, of which the chief only need be recapitulated here—viz.:

1. Keeping the intestines well over to the opposite side by carefully applied gauze. 2. By the same means keeping the general peritonæal cavity shut off as much as possible; as pointed out already, this method has the grave objection of more readily causing infection of the

peritonæum. 3. Avoiding all large vessels which are met with over the kidney, and securing these carefully with chromic gut or fine carbolised silk ligatures before dividing them. 4. Securing as full access as possible to the kidney pedicle. 5. Dealing as gently as possible with the kidney when distended with fluid, and still more when it is the seat of a soft vascular growth. 6. Separating adhesions, especially any situated posteriorly, with the utmost carefulness. 7. Avoiding all tension on the pedicle. 8. Scrupulously cleansing the site of the wound. 9. If fluids or portions of the growth have escaped into the general peritonæal sac, ensuring cleansing of this with sponges, or, perhaps better, by irrigation with a warm solution of normal saline. 10. Taking care that the cut edges of the peritonæum over the kidney are in exact apposition, either by natural adaptation or by the aid of catgut sutures. 11. Providing sufficient drainage (p. 153) if the operation has been a difficult one and the parts much disturbed, and especially if septic fluids have escaped into the peritonæal cavity. In this latter case irrigation with boiled water or a 2 per cent. solution of hot boracic acid must be made use of. 12. Conducting the different steps of the operation, especially the earlier ones, with as much expedition as possible, and, in addition, providing against shock by taking those precautions recommended for this purpose in any grave operation, as at p. 144.

C. **Nephrectomy through the Abdominal Wall, but without opening the Peritonæum.**—Having made use of the method in one case nine years ago, and being much struck by the room afforded, I may make brief mention of it:

The patient was a woman, aged 54, the subject of a movable kidney on the right side, the kidney being also the seat of malignant disease. As the abdominal walls were thin, and as the kidney could easily be made to project in the anterior part of the right lumbar region, I made a longitudinal incision from the anterior superior spine up to the eighth rib. The different layers were cut through, very little hæmorrhage being met with; when the peritonæum was reached, this was then stripped up out of the iliac fossa, upwards and inwards, then upwards off the anterior surface of the kidney until its vessels came in view. No difficulty was experienced in dealing with the pedicle—first the ureter, and then the vessels. The vena cava was seen for about 1½ inch receiving pulsation from the aorta. The patient never rallied thoroughly from the operation,* and sank about twenty-four hours after. The necropsy showed ligatures firmly tied; one of those on the renal vein had slightly puckered in the inner surface of the vena cava. A clot the size of the little finger constituted all the bleeding that had taken place. The kidney was, save for one small patch at the lower part, entirely converted into encephaloid carcinoma. Two or three of the aortic glands were enlarged; there were no other secondary deposits.

D. **Combination of Lumbar and Abdominal Nephrectomy.**—Dr. Hume, of Newcastle, made use of this method in a case of sarcoma (*Lancet*, vol. i. 1893, p. 196);

An incision about six inches long was first made in the linea semilunaris, and the swelling found to be in the left kidney. A lumbar incision was then made from the middle of the first cut, dividing all the structures forming the abdominal wall, including the peritonæum. The intestines were pushed to the right and protected with sponges. The peritonæum covering the kidney was then separated until the whole growth was exposed. The large cavity left was plugged with sublimate gauze dusted with iodoform, the ends of the strips being brought out through an opening in the most dependent part of the loin. The strips were removed in thirty-six hours. The patient recovered.

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* I think that the thinness of the abdominal walls prolonged the operation, owing to my anxiety not to wound the peritonæum. As has been said above, the hæmorrhage was very slight, and I was careful not to pull upon the pedicle.

E. **Mr. Knowsley Thornton's Combined Method.**—This is given at p. 134.

a. **Choice between Lumbar and Abdominal Nephrectomy.**—While it is certain that all kidneys of small or moderately large size can be easily removed by a lumbar incision sufficiently enlarged (p. 147), time alone will show whether I am right in my opinion that before the lumbar method is abandoned a trial should be made of such a free incision as König's (p. 148) when large kidneys have to be attacked. And this leads to the question of chief importance: How far is the danger really increased by going through the peritonæum to get at the kidney? I am strongly of opinion that, in spite of all the recent improvements in abdominal surgery and their success in preventing *peritonitis*, interference with and handling the contents of the peritonæum, save in the shortest and simplest instances, remains, on the score of *shock*, as grave a thing as ever it was. I am quite aware that, in the hands of a few operators, such as the late Sir S. Wells, Mr. K. Thornton, and Mr. Malcolm, removal of kidneys, even in difficult cases, through an abdominal wound involving the peritonæum, has given excellent results —results perhaps as good as, or better than, those by the lumbar method. But, while allowing this, it cannot, I think, be lost sight of that the kidney is an extra-peritonæal organ, not one, like the uterus and ovary, within the peritonæal sac. It will assuredly never come about that removal of the kidney will pass, like oöphorectomy and removal of the uterus or its appendages, into the hands of a few operators, however specially skilled in abdominal surgery. This being so, and the organ in question being one behind and outside the peritonæum, while each man will decide for himself and according to his special experience and line of work, the majority of surgeons will, I think, prefer to make their attacks from behind whenever this is possible. This question is also dealt with above (p. 134).

LUMBAR NEPHRECTOMY—ADVANTAGES:—1. The peritonæum, save in cases of exceptional difficulty, is not opened or contaminated. 2. Efficient drainage is easily provided. 3. The structures interfered with are much less important. 4. As pointed out by the late Mr. Greig Smith, "in the case of its being unwise, as in abscess, or in tumour affecting the surrounding tissues, to proceed to removal, it is less serious to the patient." 5. If the kidney is firmly matted down, as in the cases given at p. 147, such dense posterior adhesions are most readily dealt with by the lumbar method. 6. The lumbar incision, if converted into a T-shaped one, or prolonged forwards by König's method, will give sufficient room for meeting most of the conditions which call for nephrectomy. Thus modified, it will suffice for new growths.

LUMBAR NEPHRECTOMY—DISADVANTAGES:—1. It is thought by some that too little room is given by this method for the removal of large kidneys. It has already been shown (p. 148) how extensively this incision can be enlarged. It is doubtful, therefore, if this objection holds good for any cases, even those of unusually long-chested patients, or those with spinal deformity. 2. In a fat subject the organ may be difficult to reach, even when well pushed up from the front, owing to the great depth of the wound. 3. The pedicle is less easily reached,* and thus, in cases of difficulty, bleeding at a very important stage of the operation is less easily dealt with. 4. If the kidney be very adherent, important structures—*e.g.*, the peritonæum and colon—may be opened, unless great care is taken. 5. The condition of the opposite kidney cannot be examined into. Possible fallacies here have been pointed out, pp. 135, 152.

NEPHRECTOMY BY ABDOMINAL INCISIONS IN THE LINEA ALBA, OR AT THE EDGE OF THE RECTUS, THE PERITONÆAL CAVITY BEING OPENED—ADVANTAGES:—1. Additional room in case of large kidneys. 2. More easy access to the pedicle. 3. The possibility of examining the condition of the other kidney. It has already been pointed out (pp. 135, 152) that this advantage is probably overrated.

NEPHRECTOMY BY ABDOMINAL INCISIONS THROUGH THE PERITONÆUM —DISADVANTAGES:—1. The peritonæal sac is opened. 2. The same sac may be seriously contaminated if a kidney containing septic matter, or one largely converted into soft growth, is ruptured during the needful manipulations. 3. The intestines may be difficult to deal with, and may, by crowding into the field of operation and the incision in the abdominal wall, prove most embarrassing. 4. The handling and interference with the contents of the peritonæum may cause considerable shock. 5. The vitality of the colon may, by interference with its blood-supply, be endangered. 6. It is more difficult, by this method, to deal with any dense adhesions which may exist behind the kidney. 7. If bleeding follow the operation, reopening an abdominal wound, finding the bleeding points and securing them, or plugging the wound, will be attended by more shock than the adoption of the same course by the lumbar method. A case supporting this view is candidly reported by Mr. Page, of Newcastle (*Lancet*, vol. ii. 1893, p. 1187). 8. Efficient drainage is less easily provided in cases of any contamination of the peritonæal cavity, or of oozing after the kidney is removed. 9. The after-complication of a ventral hernia is much more probable by this method, though it must be allowed that the free lumbar incision already alluded to may be followed by the same result.

Causes of Death after Nephrectomy.—1. Shock.—This may be induced by hæmorrhage, much traction on the pedicle, and thus, probably, interference with the solar plexus, injury to the colon, and, where the peritonæal sac is opened, by much disturbance of its contents. 2. Hæmorrhage.—This is especially to be dreaded where the pedicle is deep and difficult to command; where there are aberrant renal vessels; where these vessels are enlarged and perhaps softened; where, owing to too much tension on the pedicle, a vessel retracts from within its loop of ligature; where the kidney capsule and tissue are broken into. In the intra-peritonæal method there is the additional danger of enlarged veins within the meso-colon. Secondary hæmorrhage has been alluded to above, pp. 131, 151. 3. Uræmia and Anuria.—These are only likely to occur when it has been impossible to form a correct estimate of the condition of the opposite kidney, or where, to give a patient a chance, the surgeon operates in what he knows to be a doubtful case. Where there is reason to believe that the suppression of urine may be due to a calculus in the opposite kidney, this should at once be cut down upon in the hope of finding a calculus that can be removed. Mr. Lucas's brilliant example of what nephrolithotomy may do, when such peril sets in at a later date, has been referred to at p. 137. 4. Peritonitis.—This, if septic, is due either to mischief introduced at the operation or from the kidney. While it is certainly more likely to follow the intra-peritonæal operation, it may occur after that through the loin, especially when much difficulty is met with here, owing to numerous adhesions, or to working in a wound of insufficient size.* 5. Septic trouble—Cellulitis—Erysipelas—Pyæmia.—These are especially likely when the kidney contains septic matter, when the soft parts are much bruised, or when many fingers enter the wound. Other, rarer, causes of death are—6. Pulmonary Embolism. 7. Empyema.—This may be brought about by an extension of septic cellulitis, or by removing, during the operation, a portion of rib in order to get more room—a step the danger of which cannot be too strongly enforced (p. 123). An anatomical predisposition favouring the passage of inflammation from the kidney to the pleura has been pointed out by Dr. Lange, of New York. This authority on renal surgery found, in one subject, an enormous gap in the diaphragm, the muscle fibres being absent from the ligamentum arcuatum internum as far as the outermost part of the eleventh rib. Between these two points the fibres of the diaphragm communicated in a high arch, bounding an area in which the fatty tissue about the kidney was in direct contact with the pleura. 8. Intestinal Obstruction.—This occurred fatally in one of Mr. Thornton's cases. He thought it was brought about by his suturing the two edges of the peritonæum over the kidney together, and thus producing kinking of the large intestine.

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* This objection and the next can be met by a very free incision (p. 148).

Partial Nephrectomy.—This has been rendered justifiable by the results of experiments on animals. Morris (*loc. supra cit.*) says, "Tuffier's experiments on animals, in 1888, and Barth's histological researches supply ample proofs of the healing power of the kidney, and the process by which healing is accomplished, even after extirpation of considerable portions. Paoli, of Perugia, performed extra-peritonæal operations for resection of the kidney upon twenty-five dogs, cats, and rabbits, with perfect recovery."

Morris also gives a *resumé* of eleven operations, three for cysts, three for calculous pyonephritis, two for new growths, and one each for puerperal pyonephritis, renal fistula, and a patch of interstitial nephritis mistaken for malignant disease.

None of these cases died; nine made good recoveries, one required nephrectomy, and in one fistula resulted.

Ramsay (*loc. supra cit.*) mentions nine cases of partial nephrectomy for tuberculous disease; in only two of these, however, was the result

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* During a nephrectomy for pyonephrosis the peritonæum was injured owing to the adhesions of the renal capsule. As it was thought certain that some septic fluid had escaped into the peritonæal cavity, this was opened by a small incision above the pubes after the lumbar wound had been closed. Some ounces of bloody fluid escaped, the cavity was washed out, and a drainage-tube placed in Douglas's pouch. The patient recovered. (F. Page, *Lancet*, vol. i. 1893, p. 999.)

Lumbar Nephrectomies.

No.	By whom sent.	Sex.	Age.	Disease.	Result.
1	Dr. Moxon	F.	45	Carcinoma.	Death, about thirty hours after, from prolonged shock. This kidney, though greatly enlarged, was got out through a very free lumbar incision by tilting its long axis into that of the wound. I see now that I took up too much time in tying every small vessel as I went along. Two of the glands on the vena cava were carcinomatous.
2	Mr. E. O. Day	M.	27	Very long standing pyelitis; drainage	Recovery. This patient had had cystitis nearly all his life. Eight years before, he had been cut for vesical calculus in Nottingham. He was sent to me in a state of septicæmia, due to a most foul pyelitis. This was drained, but a sinus persisted, and fourteen months later I removed the kidney. This was very small, and so universally and firmly adherent that it had to be literally dug out by the finger. The man had constant hiccough for a fortnight, possibly due to some injury to the phrenic or the diaphragm.
3	Dr. F. Taylor	F.	42	Tubercular pyelitis	Recovery. She is alive eight and a half years later, with no irritability of the bladder, and passing no pus.
4	Dr. Phillips, Bedford	M.	—	Tubercular pyelitis	Recovery, eleven years ago. He completed his terms at Cambridge and took curacies. Fourteen months after the operation he began to show signs of tubercular mischief in the prostate and vesiculæ seminales. A little later he, most unwisely, married. Two children were born, each quickly dying. When last heard of, nine years after the operation, he was holding a chaplaincy abroad; a sinus had apparently formed in connection with the stump of the ureter.
5	Dr. Phillips, Faversham	F.	3	Sarcoma.	Recovery from operation. Death two months later. The renal vein was found thrombosed with growth at the operation.
6	Dr. Perry	M.	$2\frac{1}{2}$	Cystic disease, ? congenital	Recovery.
7	Dr. G. Newton Pitt	M.	30	Calculous pyelitis	Recovery. A year before, I had performed nephro-lithotomy and removed eight stones. A most fœtid sinus persisted, kept up by a phosphatic stone, which I had left behind in the upper end of the kidney.
8	Dr. F. Taylor	F.	18	Tubercular pyelitis	Recovery. The kidney had been explored and drained six weeks before.
9	Dr. J. B. Howell, Wandsworth	F.	23	Pyonephrosis; no cause was made out	Recovery. The kidney had been explored and drained five months before.
10	Dr. B. Scott, of Bournemouth.	F.	34	Hydronephrosis.	Recovery. In this case there had been colicky pains and frequent micturition, simulating calculus, for three and a half years. A swelling had been noticed for a few months. This was first drained, and, three months later, the kidney was removed.

Lumbar Nephrectomies (continued).

No.	By whom sent.	Sex.	Age.	Disease.	Result.
11	Dr. G. Newton Pitt	F.	26	Tubercular pyelitis	Recovery. T. bacilli in urine. Kidney when removed in an advanced stage of caseation and excavation. Two sinuses remained here which closed firmly after being scraped out. Owing to presence of vesical pain and inability to hold water, $AgNO_3$ ʒij-℥j. was applied to mucous membrane of the bladder. As a result the patient was able to hold her water for three hours. It is to be feared, however, that the disease in the kidney had lasted too long, and that in the bladder was too advanced to admit of a permanent cure. The disappearance of hectic and the gain of flesh were, however, very marked after the nephrectomy.
12	Dr. F. Taylor	F.	22	Tubercular pyelitis. Tubercle bacilli found in the urine.	Recovery. Previous drainage. Removal of kidney a month later. Two and a half years later patient reports herself as "in the best of health."
13	Dr. Luscombe, of Twickenham	F.	34	Tubercular pyelitis	Recovery. Drainage of the kidney and, at the same time, removal of a calculus from the ureter one a half inches below the pelvis. Removal of kidney three weeks later. Severe parotitis three weeks afterwards, requiring incisions. I saw this patient three years afterwards. She was well and strong, and had borne a healthy infant.
14	Dr. F. Taylor	M.	18	Hydronephrosis	Recovery. Frequent pain in left side, alternating with vomiting. Kidney dilated into a very large sac, extending up under ribs. Removal without previous drainage. Small part of the cyst left behind for security of ligatures. The hydronephrosis was probably due to an abnormal arrangement of the renal vessels, and thus pressure on the ureter.
15	Dr. Sandoe, of Broadclyst	M.	35	Tubercular pyelitis	Recovery from the operation. Patient had had one forearm amputated for "strumous disease of wrist." Admitted for perinephritic abscess This was drained. A month later the kidney was removed. The presence of tubercle bacilli continued in the urine. The wound was not quite healed when the patient left, and he died from exhaustion and failure of the other kidney two months after leaving the hospital.
16	Dr. Blood, of Birkenhead, and Dr. Goodhart	F.	31	Tubercular pyelitis. No bacilli found.* A sister died of pulmonary phthisis.	Recovery. The kidney showed most extensive caseation and early vomicæ. I have seen this patient recently, nearly five years after the operation, and her health is excellent.
17	Dr. Uhthoff, of Brighton, and Dr. Goodhart	M.	14	Tubercular pyelitis, and probably early cystitis	Recovery. The kidney here was greatly enlarged. Fortunately it was not very fixed. It was got out through a lumbar incision much prolonged, and T-shaped. About six months later I had to scrape out two sinuses, probably connected with the stump of the ureter, which was in a state of advanced disease. About three years after the nephrectomy, castration was required for tubercular disease of one testicle, and a little later he was placed under my care again for a sinus connected with the castration wound. The cut end of the vas was found to be tubercular and was freely removed. All has been soundly healed for nine months, but the outlook is very gloomy.

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* I was informed of the result, the examination of the kidney having been made at Liverpool.

Lumbar Nephrectomies—(continued).

No.	By whom sent.	Sex.	Age.	Disease.	Result.
18	Dr. Galabin.	F.	38	Carcinoma.	Recovery from operation. Here there was some question whether the large kidney would come out through a lumbar incision. This was effected by a very free incision and tilting the long axis of the kidney into that of the wound. The patient died five months afterwards of secondary deposits.
19	Dr. Halstead of Ramsgate.	M.	57	Hydronephrosis. No previous drainage.	Recovery. Here a sinus persisted for over a year after the nephrectomy, due to a piece of silk. I have seen this patient lately, four years after the operation, in excellent health.
20	Accident, Guy's Hospital.	M.	13	Laceration of kidney. Other injuries.	Death. This patient was in a most grave condition when I was asked to see him. Forty-eight hours before, a van-wheel had passed over his abdomen and chest. Hæmaturia had been constant, profuse, and accompanied with clots. The region of the right kidney was occupied by a very tender swelling. The patient was delirious, due, I thought, to absorption from the breaking down clots, and the pulse scarcely perceptible owing to the hæmaturia. To give him a chance I performed nephrectomy, which was as simple as possible. The kidney was found torn in half, one part being connected with the ureter, the other with the vessels. Transfusion was performed, but nephrectomy came too late, and the patient sank a few hours later. The necropsy showed bruising of the liver, some blood in the peritonæal sac, which was uninjured, and much effused around the cæcum and ascending colon.
21	Dr. F. Taylor.	F.	35	Calculous pyelitis. Bilateral.	Death. At the time of the nephrectomy, one large irregular calculus and several small facetted ones were removed from the right kidney. As this was much enlarged, its cortex indurated, pale, and atrophied, it was removed. Three days later it is noted that thirty-six ounces of urine were passed in the previous twenty-four hours. This quantity gradually lessened, sickness gradually increased, and the patient sank fifteen days after the operation. The necropsy showed that the left kidney was also the seat of hydronephrosis, and the ureter here occupied by a calculus.
22	Royal Hospital for Children and Women.	F.	21	Tubercular pyelitis.	Death. Eight years before, I had excised the right knee-joint of this patient. The right kidney was greatly enlarged and much thickened, there being but little pus in proportion to the advanced caseation. It was extremely adherent, especially above, under the diaphragm. Towards the close of the operation, as I was clearing the pedicle, which was much overlapped by the enlarged kidney, I wounded the vena cava. The opening was properly clamped and ligatures placed above and below. The operation was most difficult throughout, and accompanied by much shock. Transfusion was resorted to, but the patient sank three hours later.
23	Dr. Brogden of Ipswich.	F.	23	Pyonephrosis.	Recovery. Pain had existed in the right kidney for eight years. Nephrorraphy and, later on, nephro-lithotomy (three oxalate calculi had been removed), had been performed by Dr. Brogden, with great relief for some years. The kidney was much dilated, with a very wasted cortex. Three oxalate calculi were found in the upper and two in the lower end, all very minute and in dilated calyces.

satisfactory. One, reported by Israel, was well one year later; the other, by Morris, was well two years later.

This operation may also be performed in cases of laceration of the kidney by injury, where the greater part of the organ is uninjured. Here the organ will very likely be healthy, and removal of an almost detached part may be sufficient to arrest the hæmorrhage. Mr. Keetley has recorded a case of this kind (*Lancet*, vol. i. 1890, p. 134):

A young man had been crushed by a waggon-wheel. There was laceration. Five or six hours after the accident he showed signs of serious recurrent hæmorrhage. Through an incision a mass of blood-clot was scooped out, also the separated lower end of the kidney, a deep bleeding point being compressed with sponges, which were removed in twelve hours. Convalescence was rapid. No urinary fistula or hydronephrosis resulted.

It may be said, therefore, that where, on examination of the kidney, a suitable opportunity presents itself, partial nephrectomy may be performed, and the greater part of the kidney in this way saved. The wound in the kidney may be sutured or the hæmorrhage may be arrested by means of plugging with iodoform gauze, suturing being the preferable method where possible; for in this way both hæmorrhage and escape of urine will be prevented, and rapid healing of the whole wound thus secured.

In view of the unsatisfactory results that have attended this method of treating tuberculous disease, and of the great difficulty there must be in making certain that all disease has been removed, it would seem wiser to remove the entire kidney in such cases.

Results of Nephrectomy.

The foregoing list shows twenty-three cases with four* deaths. Tubercular cases, where the mischief is advanced and the adhesions extensive, as in case 22; malignant growths; and cases of calculous pyelitis where both kidneys are affected, though one only at the time of operation may contain stones, will always keep up the mortality of nephrectomy.

Mr. H. Morris (*Surgery of the Kidney and Ureter*, vol. ii. p. 275) gives the following statistics of his cases: (*a*) In twenty-nine nephrectomies for calculous disease, there were five deaths; (*b*) in twenty-four nephrectomies for hydro- and pyonephrosis there were three deaths; (*c*) in twenty-two nephrectomies for tuberculosis there were five deaths; (*d*) in seventeen nephrectomies for tumour there were four deaths; (*e*) in three nephrectomies for fistula there were no deaths. Thus, there were seventeen deaths out of ninety-five cases.

NEPHRORRAPHY.

It is well known that nephrorraphy has not always been followed by the relief expected. This, I think, is due to one or more of the following causes:

1. The operation has been performed in unsuitable cases. (A.) Cases where the mobility of the kidney is only, in reality, a small part of the

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* I have included No. 20, as I performed the nephrectomy. The case was, however, admitted under the care of another surgeon, and I was only called to it at the very end. On the other hand, case 15 ought, perhaps, to be accounted a fatal case of nephrectomy.

trouble. Well-marked instances of this group would be those cases where mobility of the kidney co-exists with a markedly neurotic tendency, a group in which, were it not for the above tendency, the mobility of the kidney would be little complained of; a group in which operation has been resorted to far too often, thus bringing much discredit upon it; a group, finally, in which nephrorraphy is rarely to be resorted to, and then only with the greatest caution.* In dyspeptic, neurotic women approaching the menopause the operation should be avoided altogether. In the neurotic tendency lies one of the chief difficulties with regard to making a decision on the question of operation. The frequency with which a highly nervous temperament is present suggests the obvious question, Would these symptoms have arisen were it not for the neurotic tendency? Any honest medical man would answer that in the majority they would not. In a certain number the mobility of the kidney determines the region and distribution of the neurotic trouble; in a very few it originates and causes the neurotic tendency.† Again, where the mobility of the kidney is associated with a general proptosis of the viscera, especially of the liver, with long-standing dyspepsia or constipation, or with uterine or ovarian trouble, it will be useless to perform nephrorraphy, unless the other ailments can be corrected—a matter of no little doubt and difficulty in some of those patients in whom we meet with this disorder. (B.) In a certain proportion of movable kidneys—and this, perhaps, a larger one than is usually allowed—organic disease coexists as well. I have met with three such cases. In one (Case 1, Table, p. 159) the kidney was the site of carcinoma; in a second (Case 8, *loc. supra cit.*), early tubercular disease must have been present. About two months after the nephrorraphy, pain having returned, further examination showed that the urine, which had before been found normal, contained pus. At a second operation two early foci of tubercular suppuration ‡ were found and the kidney was removed. Six years later the patient was alive and well. The third case was one associated with hydronephrosis. At this time, when performing nephrorraphy, I was passing my sutures through the tissue of the kidney itself, a method which I now consider quite unreliable, and I am doubtful if the relief given in this case of hydronephrosis was permanent. The question of nephrorraphy in hydronephrosis is referred to below.

2. Another frequent cause of nephrorraphy failing to give permanent relief is the way in which the operation is performed. Too often the peri-renal fatty tissue has been thoroughly pulled out, some of it

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* In an interesting paper by Dr. Drummond (*loc. infra cit.*), thirty cases of movable kidney are given, two of which were treated by nephrorraphy. Both relapsed. In a third case, the details of which were supplied to Dr. Drummond, "excision of the movable kidney was practised without any relief."

† As in the rare cases where a man, previously active and healthy, has his life spoilt and becomes hypochondriacal after one kidney has become movable.

‡ My silk sutures, with which the kidney had been fixed, were found *in situ*, but as the collections of pus were on the inner aspect of the kidney, I do not think they dated to the stitching, in which the kidney substance had been boldly taken up. The early appearance of pus after the nephrorraphy is, however, suspicious, and it is quite possible that in delicate patients the injury inflicted by suturing might be the starting-point of tubercular disease of the kidney.

removed, and its edges sutured to the lips of the wound. Frequently the kidney is already movable within this capsule, and no good results, and where no such mobility has existed, the loose fatty tissue, however carefully pulled out, tightened and stitched, gradually stretches and ceases to fix the organ. In other cases the operator tries to pass his sutures so as to take up the capsule of the kidney without regarding more than the surface of the cortex. Such a hold is insufficient. In other cases—and this is very frequent—the kidney tissue itself is deeply traversed by the needle. Now, the friability of the kidney is well known. Every operator who has passed sutures in this way is familiar with their tendency to cut through before or just as they are finally tightened and tied. So soft is the tissue of the kidney, especially when injured and inflamed—as around a suture—that I believe that, even when silk sutures thus passed have been left *in situ*, their cutting through is only a matter of time. When catgut, however stout, has been employed the result is still worse. Like silk, it is very liable to cut its way through the easily lacerable kidney tissue as it is tied; if it does not do so then its softening takes place so quickly in the vascular kidney tissue that any permanent anchoring by the blending of this material with other tissues is impossible.* Moreover, there is another danger, not altogether a fanciful one, which may follow on deeply puncturing the kidney. A German surgeon, Barth, has seen a necrotic centre caused in the kidney owing to the occlusion of one of the arterial centres by the anchoring suture. A similar condition has been noted as the result of puncture. One of the large arteries was obstructed, hæmorrhagic infarction took place, and ultimately necrosis (M'Ardle, *Brit. Med. Journ.*, vol. i. 1894, p. 526). A fourth step that has been advised, scarifying the surface of the kidney and scraping the adjacent muscles and fasciæ does not commend itself to me as satisfactory at the time or likely to be of permanent utility later.

To speak of the indications more exactly. Where an otherwise healthy kidney is very movable, especially where this dates in sensible people to an injury, if the surgeon is in doubt as to an operation, he should try and satisfy himself that other treatment, including a sufficient trial of a well-fitting belt, has failed, that the pain, whether constant or paroxysmal, is *bonâ fidè*, and that it really cripples and spoils the patient's life. Constipation and dyspepsia will of course have been treated, tight lacing given up, and a trial made of a well-fitting belt, or a corset coming low down in front and so fitted as to gather up the lower part of the abdomen and its contents. Thus, conditions of movable kidney which call for operation are: When it is accompanied by undoubted vomiting, or when, on the patient's stooping, the viscus comes down so far as to be jammed between the ribs and the crista ilii.

Another strong indication for nephrorraphy is early hydronephrosis. Here the operation is resorted to not only to save the patient from the pain caused by the movable kidney, but to "prevent the organ from bringing about its own destruction" (Lucas). Mr. Lucas (*Brit. Med. Journ.*, vol. ii. 1891, p. 1344) relates four cases in which mobility of the kidney allowed of displacement of the organ on its transverse axis, causing bending of the ureter,[*] and thus distension of the pelvis with urine. Two of the cases were treated by nephrorraphy, and when last seen remained cured. One of the cases, in which the hydronephrosis was undoubtedly due to the displacement, seemed to show that the destruction of the kidney may occasionally go on without any severe attacks of pain.

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* Dr. Newman drew attention to this fact several years ago (*Lects. on the Surg. Dis. of the Kidney*, p. 69): "The sutures passed into the kidney became destroyed more rapidly than elsewhere; the living renal tissue seems to have an unusual power of absorption."

The following questions arise as to the sutures. (1) What is the best material? (2) What tissues are to be taken up?

The answer to each of these questions is, in my opinion, a simple one. (1) Silk, which is easily obtained and readily sterilised, with a little care will be quite efficient. It should not be of the plaited kind, it should be of medium size and carefully prepared. Buried as it is deeply, the use of silk here is not open to the objections to which I have alluded in the account of Radical Cure of Hernia. Kangaroo-tail tendon is another excellent material.

(2) In answer to this question I am strongly of opinion that to ensure a permanent cure in nephrorraphy, the sutures should take hold of the proper capsule of the kidney itself, after this has been careful peeled off in two flaps. I have tried other methods, *e.g.*, inserting them through the substance of the kidney itself, either fastening them to each side of the wound and dropping them in, or passing them from one lip of the wound through the kidney and finally through the other lip of the wound. The longer I watched my cases the less reason had I to be satisfied, though the earlier results had been excellent.

I have used the following method in fifteen cases, four of which were bilateral. One case, a patient of Dr. Brogden's, of Ipswich, was operated on eleven years ago. She remains well, having married and had a child since the operation. Of the others, in one only do I know of the organ becoming loose again, a patient sent to me by Dr. W. A. Davies, D.S.O., of Johannesburg. In two others, owing to the patients being moved too soon, the wounds reopened. This caused considerable trouble.

Operation.—The kidney is first thoroughly exposed by the steps given at p. 123, an assistant keeping the organ well pushed up into the loin while the surgeon cuts down on it. I may here say that in some of these cases of very movable kidney the tissues around are so loose from the dragging and shifting to and fro of the kidney that they wrap round the organ very closely, and thus it is easy to injure the peritonæum. Thus, in one of the patients mentioned above the right kidney was mobile through an extremely wide range, and so loose that when lying on her left side the patient could make it project as a convex lump in the left iliac fossa. When I was operating on this side I found the kidney easily reached, but not easy to define, owing to the extreme looseness of the folds of the perinephritic tissue and peritonæum.* This latter structure I opened in two places, the thin edge of the liver appearing at one, and some omentum in the other. The first opening was clamped and tied up with a catgut ligature, the second closed with a continuous suture of the same. Strict aseptic precautions were taken, and not the slightest ill result followed.

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[*] This same displacement of the kidney, which occludes for a time the ureter, will also, by twisting the pedicle, affect its vessels. As Mr. Lucas points out, the vein will suffer more from pressure than the artery, thus causing turgescence of the organ generally as well as distension of its pelvis. Thus are brought about the nausea, pain, vomiting, &c., which have been described as strangulation or acute dislocation of the kidney. (Bruce Clarke, *Trans. Med.-Chir. Soc.*, vol. lxxvi. p. 263; *Brit. Med. Journ.*, vol. i. 1895, p. 575).

The kidney itself having been exposed, it is gently withdrawn through the wound, surrounded with aseptic gauze while an incision is made with a very light hand all along the convex border from end to end. Unless the utmost gentleness is taken in the last step the tissue of the organ itself will certainly be incised, causing free oozing. With the handle of a scalpel or a blunt dissector, flaps of capsule are then deliberately but gently stripped off the kidney up to a point about halfway along its lateral surfaces, so as to raise sufficient flaps for the sutures to find a holding in. The flaps having been raised they are sutured with medium-sized sterilised silk to the aponeurotic and subcutaneous edges of the wound. To get a firm and permanent holding, each suture should take up plenty of capsule on the one side and a sufficient grip of the lumbar fascia on the other. I generally use upwards of twenty sutures, perhaps twelve in one flap and eight in the other. One word of caution should be added. This method of anchoring is so efficient that, unless care is taken, it is possible to fix the kidney, which has been drawn out, actually between and not beneath the lips of the wound. After one row of sutures, say the upper, has been inserted, tied and cut short, and the second merely inserted, care should be taken gently to push the kidney into its proper place in the loin, just under the wound; the lower sutures are then also tied, cut short, and dropped in. Any oozing met with after stripping off the flaps of capsule will yield to firm sponge-pressure kept up by an assistant while the surgeon is putting in his sutures. It is well also to keep a sponge in the lower part of the wound, to be removed before the last sutures are tightened. If when all bleeding is arrested the wound is very carefully dried out and dusted with sterile iodoform, no drainage-tube will be required. In closing the wound I unite the edges of the cut lumbar fascia with buried sutures of chromic gut, and the skin with salmon gut. I recommend this method most strongly: it is both easy and efficient, and sufficient time has now elapsed in several of my cases for me to be able to say that no injury is inflicted on the kidney by the stripping off of its capsule. So convinced am I of the superiority of this method that I shall not occupy my space or my readers' time in describing any other.

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* This was not a mesonephron, an exceedingly rare condition. I find that Dr. Drummond, of Newcastle, described a similar condition several years ago ("Clinical Aspects of Movable Kidney," *Lancet*, vol. i. 1890, p. 121): "In almost every instance in which the kidney has been found to be freely movable, the other abdominal organs have been correspondingly loose in their attachments—the spleen, liver, cæcum, stomach, &c. More than once a distinct mesonephron was present, but much more often the peritonæal covering was simply loose, so that the organ could be easily placed in various novel positions. At times the kidney had dragged the relaxed peritonæum so far from the abdominal wall as to bring into close conjunction the upper and lower layers, so as to form a false mesonephron."

OPERATIONS ON THE URETER.

There are two main conditions in which operations on the ureter are necessary:

A. **Ureteral Obstruction.**

B. **Injuries to the Ureter.**

A. **Ureteral Obstruction.**—This in the great majority of cases is due to the impaction of a calculus in the ureter; in others, however, it has been found to be due to a valvular formation at the opening of the ureter into the renal pelvis or to a stricture of the ureter. These conditions will be considered separately.

I. URETERAL CALCULUS.—Impaction of a calculus may take place at almost any point in the course of the ureter, although in most cases impaction occurs either at the upper extremity of the ureter close to the kidney, opposite the brim of the pelvis, or at the vesical orifice. There can be no doubt whatever that in many cases, where a renal calculus has been diagnosed and no calculus found, the stone has really been in the ureter. With more thorough exploration of the ureter, however, in every case where no stone is found in the kidney, failure of the operation from this cause will doubtless be prevented. The methods of dealing with these cases will now be considered under different headings, according to the site of impaction of the calculus.

1. *Impaction of a Calculus at or above the Brim of the Pelvis.*—In these cases the ureter can be sufficiently exposed by prolonging the incision already made for exploring the kidney as above described (*vide* p. 126).

In some cases the dilatation of the ureter above the site of impaction will allow of the calculus being pushed gently along the ureter, either up to the kidney or, at any rate, to some more accessible part of the ureter. Tuffier (Duplay and Réclus, *Traité de Chirurgie*. t. vii. 1892), during a lumbar nephro-lithotomy, in which examination of the kidney revealed no stone, detected a hard oval body about three centimetres long, where the ureter crossed the pelvis brim. The stone was movable and was pushed up into the pelvis of the kidney, and removed by an incision into the convex border. The patient recovered.

If the stone cannot be pushed up as far as the kidney, or is so tightly impacted that it cannot be moved, it should be removed through a longitudinal incision in the ureter. The incision in the ureter may be sutured with fine silk or catgut, passing through the outer coats, or it may be left without sutures. Should inflammatory thickening or ulceration of the ureter be present, it would seem wiser not to insert sutures. A number of successful cases, both with and without sutures, have been recorded. The following case, described by Dr. Kirkham (*Lancet*, March 16, 1899), is an illustrative one, and is, I believe, the first case in which a patient has been saved from death from suppression of urine by the removal of a calculus low down in the ureter:

The patient was 58. He had twice suffered from right renal colic, and had passed a small calculus. May 24, left renal colic came on. No urine was passed from this date till after the operation. May 30, the patient was drowsy, with prostration and muscular twitchings. Dr. Kirkham then explored the kidney in the hope that if no calculus was removed life might be saved by affording an outlet to the urine by an incision into the pelvis of the kidney. An incision was made from the tip of the last rib towards the anterior superior spine. No stone being found in the kidney, the exploration was continued along the ureter, in which a stone was distinctly felt about half an inch above where the ureter crosses the external iliac. There was a little difficulty in reaching the ureter in this part of its course, but after enlargement of the wound a calculus about the size of a date-stone was removed. A little urine escaped from the incision into the ureter. No sutures were placed in this. Half an hour after the operation an ounce and a half of urine was passed naturally. Very little escaped from the wound in the ureter, and the patient made an excellent recovery.

2. *Impaction of a Calculus in the Pelvic Portion of the Ureter.*—In the male, the greater part of the pelvic ureter can be exposed by a prolongation of the lumbar incision already made for exploring the kidney as recommended by Morris (*vide* p. 126).

Should the patient, however, be fat, and the lumbar incision already very deep, this method will be found to be extremely difficult. In such cases, and also in the female, the abdomen should be opened by an incision in the semilunar line or through the rectus sheath. In most cases it will then be found possible to push the calculus along the dilated ureter up to or near the kidney, when its removal can be accomplished through the lumbar incision, and the abdominal wound closed. This plan was first carried out by Lane in the following case (*Lancet*, 1890, vol. ii. p. 967):

A woman, aged 23, had had symptoms of renal stone for twenty years, but there was nothing to point to the fact that the stone was in the ureter and not in the kidney, except that, associated with her renal pain, she complained at times of pain in the lower part of the abdomen on the same side, which did not appear to be reflected. The kidney was explored by the lumbar incision, and nothing found either in this organ or in those parts of the ureter which could be reached from above or *per rectum.* The pain having returned with its original severity, the abdomen was opened along the left linea semilunaris, and in the portion of the ureter which had not been explored at the previous operation a small stone was felt. This was forced upwards along the ureter to the crest of the ilium, and by means of a small incision in the side the ureter was exposed and the stone removed. The aperture in the ureter was sewn up by a fine continuous silk suture. No leakage took place from the ureter, and the woman recovered completely, losing all her pain and discomfort.

It may, however, be found impossible to push the calculus up the ureter, owing to firm impaction or to insufficient dilatation of the ureter above the calculus. In this case the calculus must be removed through the peritonæum, and the ureter, if possible, sutured, drainage in case of leakage being provided for by means of a tampon of iodoform gauze. In a case recently operated upon by one of us (F. J. Steward, *Clin. Soc. Trans.*, vol. xxxiv.) this was done, and the ureter and peritonæum sutured:

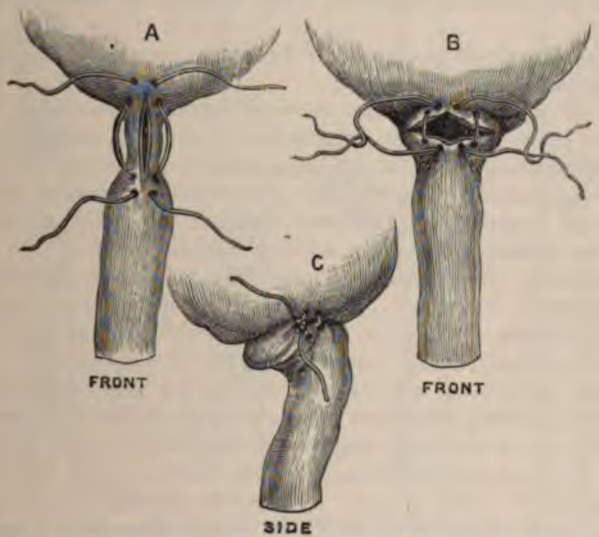
The patient was admitted for hæmaturia and painful micturition, which, in the absence of pain or tenderness over either kidney or ureter, were thought to be due to a vesical calculus. As the sound detected nothing, the bladder, after being distended with air, was opened above the pubes. Nothing was found in the bladder, but through its walls a stone could be felt in the lower part of the right ureter. As the stone could not be worked down towards the bladder the wound was closed. Eight days later an incision about five inches long was made in the lower part of the right linea semilunaris and the peritonæal sac opened. The stone was easily felt, and was gently manipulated up the ureter as far as a point a little above the iliac vessels. As it would go no further, the peritonæum and then the ureter were incised and the stone, weighing nine grains, removed. The ureter was then closed with a fine silk suture, taking up the outer coats only; the peritonæum was then sutured in like manner, and the wound closed with the exception of a small part through which a gauze drain was brought. No leakage occurred, and the patient made a satisfactory recovery.

Other methods have, however, been adopted. Emmett and Cabot have both successfully removed ureteral calculi through the vagina, while Ceci records a successful case in which he removed the stone through the rectum. The latter method cannot, however, be considered safe.

3. *Impaction at the Vesical Orifice.*—A number of successful cases of removal of calculi in this position have been recorded. This has been done, in the female, after dilatation of the urethra, by Emmett, Berg, Richmond, Czerny, Sänger, and Thornton. Tuffier has also removed stones in this position twice by supra-pubic cystotomy.

II. Valvular Obstruction.—Simon, in 1876, gave theoretical directions for the relief of this condition; the first successful operation was, however, performed by Fenger, of Chicago, in 1892. The method of dealing with the condition may be gathered from the following *résumé* of Fenger's case (*Ann. of Surg.*, vol. xx. 1894). The patient was a woman, aged 28, with intermittent hydronephrosis due to a movable kidney. The pelvis and calyces were first explored and no stone found. As the ureter could not be catheterised, a small opening was made in the posterior wall of the infundibulum, when a valvular obstruction was found at the upper end of the ureter where it joined the renal pelvis. The valve was divided vertically, and the ends of the longitudinal incision united by sutures, so as to convert the incision into a transverse one. The incision in the infundibulum was then closed with sutures, and the kidney fixed in the loin, a bougie being passed through the wound in the renal parenchyma and retained in position in the ureter for two days. The

Fig. 41.



Illustrating Fenger's operation for stricture of the ureter. (Morris.)

patient recovered without a fistula, and subsequently had no return of the hydronephrosis.

III. STRICTURE OF THE URETER.—Various plans have been adopted by different surgeons to remedy strictures of the ureter, the chief being the plastic method of Fenger (*loc. supra cit.*), dilatation by bougies (Alsberg), and resection of the strictured portion (Kuster). The first of these plans only will be here described, as it will probably be found applicable to the greatest number of cases. Moreover, this method has been successfully carried out at least three times by Fenger, Morris, and Mynter.

The details of the operation can be very well made out by reference to the three illustrations in Fig. 41. The strictured portion of the ureter is first divided longitudinally; sutures of fine silk are then passed on either side of this in order to draw the two extremities of the incision together and thus convert it into a transverse one, after the manner of the Heineke-Mickulicz operation for stenosis of the pylorus. Further sutures, passing through the outer coats only, now bring the edges of the rest of the incision together, thus folding the ureter on itself to some extent.

The following short account of Fenger's case well illustrates the brilliant success of the operation:

"Traumatic stricture of ureter close to entrance into pelvis of kidney; intermittent pyonephrosis for twenty-four years; increased frequency of attacks. Nephrotomy; no stone in sacculated kidney, ureteral entrance could not be found; longitudinal ureterotomy revealed stricture at upper end of ureter; longitudinal division of stricture and plastic operation on ureter. Recovery without fistula."

B. **Injuries to the Ureter.**—These may be met with either in the form of traumatic ruptures, or of accidental division or removal of a piece of the ureter during the course of certain abdominal operations, such as hysterectomy or the removal of a pelvic tumour.

Traumatic rupture of the ureter has not yet been treated by direct suture. This is owing doubtless to the extreme difficulty in the diagnosis of this condition in the early stages, for most of the cases have not been recognised until an accumulation of urine, blood, or pus has formed and has been opened. The tumour due to the accumulation may not be noticed for some time, two to three weeks (Stanley, Page, Barker, Hicks), thirty-nine days (Croft), and in one case (Stanley's) not until seven weeks after the injury.

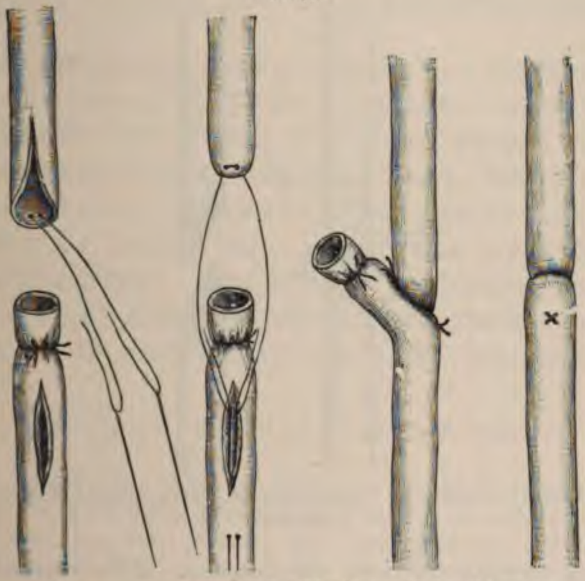
For accidental division or removal of a piece of the ureter during the course of an abdominal operation, a very large number of different operations have been performed. It is impossible here to mention or describe all these operations. An attempt will, however, be made to indicate the methods which are likely to be found most suitable to the various conditions that may be met with.

In the great majority of instances it will be found possible to directly unite the divided ends of the ureter. The results that have so far attended the various methods of bringing this about clearly show that it should be done wherever possible. Bovée (*Ann. of Surg.*, Aug. 1900) mentions twenty-seven published cases with only two deaths, and not in one was there failure to unite. If the ureter has been simply divided without loss of substance, and if both the ends are accessible and the upper end will not reach the bladder, then, because it is the most simple method to carry out, and because it is the least likely to be followed by stricture, the following operation, devised by Van Hook (*vide* Fig. 42), should be performed. The following are the steps of the operation as given by Fenger (*loc. supra cit.*):

"(1) Ligate the lower portion of the tube one-eighth or one-fourth of an inch from the free end. Silk or catgut may be used. Make with fine sharp-pointed scissors a longitudinal incision, twice as long as the diameter of the ureter, in the wall of the lower end, one-fourth of an inch below the ligature.

"(2) Make an incision with the scissors in the upper portion of the ureter, beginning at the open end of the duct and carrying it up one-fourth of an inch. This incision ensures the patency of the tube.

FIG. 42.



Uretero-ureterostomy. Van Hook's method. (Morris.)

"(3) Pass two very small cambric sewing needles armed with one thread of sterilised catgut through the wall of the upper end of the ureter, one-eighth of an inch from the extremity, from within outward, the needles being from one-sixteenth to one-eighth of an inch apart, and equidistant from the end of the duct. It will be seen that the loop of catgut between the needles firmly grasps the upper end of the ureter.

"(4) These needles are now carried through the slit in the side of the lower end of the ureter into and down the tube for one-half an inch, where they are pushed through the wall of the duct side by side.

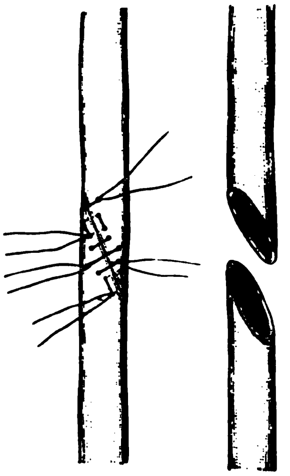
"(5) It will now be seen that traction upon this catgut loop passing through the wall of the ureter will draw the upper fragment of the duct into the lower portion. This being done, the ends of the loop are tied together securely, and as the catgut will be absorbed in a few days, calculi do not form to obstruct the passage of the urine.

"(6) The ureter is now enveloped carefully with peritonæum."

If, however, a portion of the ureter has been accidentally removed, and the upper end will not reach the bladder, it will probably be found that there will not be sufficient length of ureter available for performing Van Hook's operation. In this case the ends must be united by end-to-end suture, or by the oblique method of Bovée (*vide* Fig. 43).

Should it be found that the upper end of the divided ureter will reach the bladder, implantation into this organ is preferable to all other procedures. This may be carried out by the method of Paoli and Busachi (*Annales des Maladies des Organes Genito-urinaires*, 1888), which consists in splitting the distal end of the ureter and uniting it by sutures to an incision in the bladder, or by a modification of the operation of Van Hook for uretero-ureterostomy, the cut end of the ureter being invaginated into the bladder. This method has been adopted by Penrose and others (*Med. News*, vol. lxiv., 1894, p. 470).

Fig. 43.



Uretero-ureterostomy. To illustrate the oblique method of Bovée. (Morris.)

Finally, should such a length of ureter have been removed as to render both direct union of the two ends and implantation into the bladder impossible, the proximal end must be either implanted into the bowel or on the skin. The results of both these plans have so far been on the whole extremely unsatisfactory, owing to infection of the ureter and kidney in the case of implantation into the bowel, and to discomfort and constant irritation of the skin when the implantation is made on the skin. For these reasons a secondary nephrectomy will nearly always be necessary in such cases.

CHAPTER V.

OPERATIONS ON THE INTESTINES.

ACUTE INTESTINAL OBSTRUCTION. — APPENDICITIS. — PERFORATING ULCER OF STOMACH—OF DUODENUM —OF INTESTINE AFTER TYPHOID FEVER.—SUPPURATIVE PERITONITIS. — TUBERCULAR PERITONITIS. — ENTEROSTOMY.—FORMATION OF ARTIFICIAL ANUS.— SUTURE OF INTESTINE.—RESECTION OF INTESTINE. —ENTERECTOMY.—COLECTOMY.—INTESTINAL ANASTOMOSIS AND SHORT CIRCUITING.—ENTEROPLASTY.— CLOSURE OF ARTIFICIAL ANUS AND FÆCAL FISTULA.

ACUTE INTESTINAL OBSTRUCTION.

CONSIDERED generally, without reference to the causation of the obstruction, the successful treatment of acute intestinal obstruction depends largely on two points: (*a*) **The Question of Operation,** and (*b*) **The Question of the Extent of Interference that is indicated in any given Case.**

(*a*) **The Question of Operation.**—Although cases of so-called "spontaneous cure" have from time to time been recorded, the number of these is so small, and the correctness of the diagnosis in many of them so doubtful, that for all practical purposes it is wiser to leave them entirely out of consideration. For, apart from these and the small number of cases of intussusception that have survived the sloughing of the intussusceptum, as Sir F. Treves says, "there is no avoiding the fact that acute intestinal obstruction, if unrelieved, ends in death" (*Intestinal Obstruction*, p. 475). This being so, it clearly becomes the duty of the surgeon to operate on every case of acute intestinal obstruction. The operation, moreover, should be performed at the earliest possible moment after the diagnosis has been made, for, serious as the operation is in itself, it is not nearly so serious as delay, since the mortality rises extremely rapidly as the period between the onset of the symptoms and the time of operation increases. Neither should uncertainty of diagnosis be allowed to delay the operation, for of the many conditions that simulate acute intestinal obstruction—*e.g.*, typhlitis and appendicitis, peritonitis from different causes, thrombosis of mesenteric veins, acute pancreatitis, enteritis, &c.—in some an operation may be beneficial, while as to the others it would be better that an exploratory operation, as long as it is done by skilled hands, took place needlessly than that a remediable condition should be left untouched. Here, again, the valuable opinion of Sir F. Treves may be quoted. He says: "Operation in these cases is too often regarded as a *last* resource. It should be the *first* resource, as it certainly is the *only* resource."

The mortality of all cases of acute intestinal obstruction at the present time, as shown by Gibson (*Ann. of Surg.*, Oct. 1900) in a collection of cases operated upon between 1888 and 1898, is about 47 per cent., his list including 646 cases with 312 deaths; and although this is without doubt a vast improvement upon former times, it is still to be hoped that in the near future earlier recognition and more immediate operation will do much to bring about still further improvement. Even then the mortality will probably always be high, and this owing to the frequently complicated nature of the cause of the obstruction, the peculiar vitality of the parts which have to be handled, and the readiness with which these pass into a condition beyond recovery. Bearing in mind, however, the essentially fatal character of the condition, apart from relief by operation, every successful operation should be looked upon rather as a life saved, than every fatal one as a life lost.

(*b*) **The Extent of Interference that is indicated in a given Case.**—The operation must be according to the state of the patient. These cases of acute intestinal obstruction are not to be grouped together as all equally fit for operation, or as all certain to be relieved by operation as long as this is undertaken early. In some the condition of the patient is good, the abdomen is undistended and a prolonged search may be made. In others a precisely opposite condition is present, any prolonged exploration is out of the question, and all that can be done, if the cause is not found at once, is to open one of the most distended coils, as low down as possible, and drain the intestines (*vide infra*).

I propose to describe the operation generally first, and then to allude to **its application to the chief forms of acute intestinal obstruction.**

Operation.—The bladder is first emptied, and the abdominal wall shaved and cleansed. A water-bed should be filled with *hot* water, and if the patient's condition is bad, a hot port wine enema should be given.

The question of anæsthetics in these cases is a very important one, and should be well considered. The impeded respiration due to the abdominal distension is liable to make the administration of a general anæsthetic difficult and dangerous. The tendency to vomit is another grave danger, a sudden attack during the administration having frequently caused immediate death from choking.

Apart from these two considerations, the administration of a general anæsthetic seems to have special dangers of its own in cases of acute intestinal obstruction, for it undoubtedly often produces a complete and sudden change in the whole aspect of a case, a patient thought to be in good condition and well able to bear an operation becoming suddenly moribund within a few minutes of the commencement of the administration.

For all these reasons it is advisable, wherever possible, and especially in very bad cases, to make use of local anæsthesia only, the infiltration method of Schleich with cocaine, or β eucaine, being the most suitable.

Should it, however, be deemed inadvisable to operate without general anæsthesia, the stomach should be previously washed out if vomiting has been severe, and saline infusions, either intra-venous or into the cellular tissue of the axilla, should be made as soon as possible after the administration of the anæsthetic has been begun.

The operation to be performed will necessarily vary according to the general condition of the patient, and the mode of procedure will be described under two heads: (A) **Early Cases, or where the condition of the patient is good**; and (B) **Late Cases, or where the condition of the patient is very serious.**

(A) The surgeon makes a central incision,[*] beginning two inches above the umbilicus, and passing to the left of this he gains the middle line to descend, going quickly down to the peritonæum, but arresting all hæmorrhage before this is opened. If the linea alba is not hit off exactly, and is not quickly found, any muscular fibres are torn straight through with a steel director, and the transversalis fascia and peritonæum thus reached.

I strongly advise the surgeon to give himself plenty of room, so as to quickly get his hand in and explore efficiently. A short median incision below the umbilicus, and the introduction of a couple of fingers, is usually futile. The abdominal wall in these cases is not thinned and overstretched as in ovariotomy; hence, if inadequately opened, it grips the hand most embarrassingly. If the case has been allowed to go on until the intestines are distended, the search for the cause of the mischief will be rendered all the more difficult, and there must be sufficient room to introduce the hand freely. If an assistant skilfully keeps the edges of the wound together where this is not occupied by the inserted wrist, the intestines will not escape.

The peritonæum should always be well lifted up before it is opened, especially if there is distended bowel beneath. The opening is then enlarged with a blunt-pointed bistoury or scissors, two fingers with the palmar aspect turned upwards serving now as the best director.

The late Mr. Greig Smith advised, where the peritonæum is thin, that it be pinched up between the finger and thumb, and rolled about to see that no bowel is included.[†]

The surgeon should now decide which mode of exploration he will make use of. The following is as useful as any: If the parts are not much distended, three possible sites of strangulation should be first looked to. (1) The cæcum,[‡] which will give twofold evidence, first, its distension or emptiness telling whether the obstruction is above or below it; and secondly, the state of its appendix, whether normal or adherent, whether empty or containing some concretion. (2) Next, the internal inguinal, the femoral, and obturator rings are explored, to make sure that no tiny hernia exists, imperceptible from the outside. The fingers are next swept upwards towards the (3) umbilicus, in the hope of finding one of the diverticular bands mentioned at p. 179. If, up to this, the search has been fruitless, the brim of the pelvis is next examined, as bands of omenta are often fixed hereabouts, and also because, in women, local peritonitis, originating about the uterus or its appendages, and, in either sex, about the appendix cæci, is, not infrequently, the cause of the obstruction.

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[*] In those extremely rare cases where the obstruction can be localised to one or other side of the abdomen, a lateral incision may be made use of, either over the swelling, if any be present, or in the linea semilunaris.

[†] If much fluid is present, it now often shows itself through the peritonæum.

[‡] If the cæcum can be made out to be empty, tracing up empty coils from this will very likely lead to the obstruction. The more marked the evidence of collapsed small intestine, the greater the probability of the obstruction being high up, and the less fit the case for enterostomy (p. 221) (R. Jones, *Brit. Med. Journ.*, vol. i. 1894, p. 1123). In this case a band was found and successfully dealt with. Here the obstruction had

If the search fail—and it often will when distension is present, embarrassing the fingers in their movements, and obscuring the relation of parts—one or two of the loops which lie nearest to the wound should be carefully scrutinised.* These should be followed in the direction of increasing congestion and distension, thus leading to the obstruction. Fixity of a coil may be another aid. Where there is ground to believe that the case may be one of acute supervening upon chronic obstruction, the sigmoid and colon should be first investigated.

If this prove fruitless in cases where there is not much distension, the plan adopted by Mr. Cripps (*Clin. Soc. Trans.*, vol. xi. p. 225) is the simplest—*i.e.*, to draw out some inches of intestine at a time, bit by bit, from the upper part of the wound, passing it in again into the belly through the lower part, in such a way that at no time are more than five or six inches of intestine exposed. After drawing out and replacing some feet of intestine in this way, it is probable that, owing to the increasing congestion or resistance, the surgeon will reach the obstruction.† This is, however, a tedious method, and one only to be adopted when the condition of the patient is good.

An assistant should hold the coil from which the surgeon starts in the lower angle of the wound under a hot sponge, so as to save the surgeon going over the ground a second time.

If a search for ten minutes has failed‡ to find the cause of obstruction the following courses remain open: (*α*) Kummell's plan of allowing the small intestines to prolapse under hot aseptic towels; (*β*) emptying the most distended coil, and either closing the opening later, or (*γ*) inserting in it a Paul's tube; (*δ*) "short-circuiting."

(*α*) The objection to this method is, of course, that it is often exceed-

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been incomplete at first, one of incarceration followed by strangulation. I have mentioned a similar successful case at p. 278.

* The late Mr. Greig Smith said that as the most distended coils will rise nearest the surface, and the greater amount of bowel is within three inches of the umbilicus, there is a probability that the most dilated coils will be in sight.

† If he find that the bowel is getting healthier and emptier, the surgeon must reverse the direction of his search.

‡ "The difficulty of finding the obstruction in some cases is well shown by Madelung, who, in several cases where the seat of obstruction could not be located during life, requested the pathologist, when he made the post-mortems, to locate the obstruction by introducing his hand through an incision, allowing him from ten to twenty minutes for the exploration; in every instance he failed to find the obstruction within the specified time" (Senn, *loc. supra cit.*).

ingly difficult to get the distended coils back into their home, and that the necessary manipulations and exposure must produce shock, and may inflict serious damage. If, however, the condition of the patient is satisfactory and the amount of distension not great, it is, if done properly, and with care to prevent undue exposure of, and damage to, the intestines, perhaps the wisest course to pursue. This practice is, moreover, recommended by no less an authority than Sir F. Treves, who considers that the damage done to the intestines, by the amount of exposure necessary, is probably less than that caused by prolonged manipulations within the abdominal cavity. The abdominal incision should be made very free, and the intestines then allowed to escape between smooth-surfaced sterile towels, wrung out of salt solution at a temperature of 110° F. In this way the intestines can be immediately covered with the towels, and the further search for the cause of obstruction conducted with very little exposure or interference. Usually the seat of obstruction will be quickly indicated by fixity of some loop of intestine, which thus will not leave the abdomen.

(β) Should, however, the amount of distension be considerable, it is wiser to relieve this condition before proceeding further. To this end a different method must be adopted according to the seat of greatest distension. Should this be the large intestine, for instance, in a case of volvulus, the distended loop may be emptied, either by multiple puncture with a very fine hydrocele trocar if, which is rare, they contain only gas, or by incision if liquid fæces are present as well. Both these steps are often disappointing. Two conditions must be present to allow multiple punctures with the finest hydrocele trocar to be safe. The coats of the intestine must be sufficiently healthy, neither infiltrated nor paralysed, to allow the peritonæal and muscular coats to close the opening in the mucous by gliding over it, otherwise a fatal leakage will take place *guttatim* unless every puncture is closed by a fine parietal suture. The second condition is, that gas only must be present; liquid fæces being almost invariably present as well. A wiser course is to incise and evacuate the most distended coils. The patient being turned on to one side, the most distended loop is drawn out over a basin, incised parallel to its long axis at a point most distant from the mesentery, the rest of the coils being kept within the abdomen, and the one withdrawn carefully isolated by tampons of iodoform gauze or hot aseptic towels. As the escape of gas and fluids, owing to the paralysis of the intestine, will probably be very slow, it will be wise to follow Dr. Senn, and "resort to pouring out the contents, as it were, by seizing the gut several feet above and below the incision, and elevating it," a large quantity of fluid fæces being thus poured out. This emptying of distended coils will not only facilitate reduction, but, as first urged by the late Mr. Greig Smith (*Abdom. Surg.*, p. 436), it will diminish the harmful effects of a greatly distended abdomen, viz., dyspnœa, palpitation, and abdominal shock, and, as regards the bowels themselves, the danger of continued distension, paralysis, and absorption of toxic products. When the evacuation has been made as complete as possible, the next step will depend upon the condition of the patient. If this be good, and the relief of the distension has been sufficient to justify further exploration, the surgeon closes his incision in the intestine by Lembert's sutures, taking care to effect real inversion of the edges, and, leaving one or two of the sutures long, keeps this bit of intestine outside, entrusted to an assistant, while he continues his search for the cause of the obstruction. If this be found and removed, the opened and sutured part of the intestine must again be inspected, and its exact closure made sure of before it is returned; any sutures left long having been first cut short. Before finally closing the wound the question of cleansing the peritonæal cavity, irrigation, and the insertion of a Keith's tube into Douglas's pouch may arise.

If, on the other hand, it is found that the small intestine is the seat of most distension, then very little advantage will be gained by either puncture or incision, for the acute flexures caused by the distension will prevent more than a very small portion of the gut being emptied by each incision. In this case it is wiser to drain the intestine for a time by performing enterotomy, as described below (p. 222), and to search for and, if possible, remove the cause of obstruction after the worst of the distension has been relieved.

(γ and δ) Where the patient's condition makes any further search impossible, or where there is great distension, a temporary or permanent artificial anus must be made, or else "short-circuiting" must be performed.

As the last can very rarely help us in acute intestinal obstruction, I will first dispose of this subject. It will be remembered that I am speaking of short-circuiting as one of the courses open to a surgeon when he fails to find the cause of an acute intestinal obstruction, or rather, of an acute supervening upon a chronic obstruction. It is evident that it is only to a few cases that this method is suitable—*e.g.*, cases of matting together of coils of small intestine, as after previous mischief set up by a mesenteric gland, or appendicitis. In such cases if there is inextricable matting but no recent inflammatory changes and nothing like gangrene, a coil of the distended small intestine may be short-circuited to the most conveniently placed piece of large intestine. This is effected by the use of a Mayo-Robson's bobbin, Murphy's button, or Senn's plates (*q.v.*), according to the surgeon's familiarity with each, and the time at his disposal. In the majority of cases where the surgeon cannot find the cause, some part of the small intestine will be suffering not from chronic matting as above, but from the pressure effects of some band, orifice in the omentum, &c., and softening, or even gangrene, may be impending; then a better plan to relieve the distended intestine will be by performing enterotomy as described below, by tying in a Paul's tube,* or puncturing with a large trocar and cannula (p. 223) one of the most distended coils, this being first withdrawn and completely isolated with sterilised towels or iodoform gauze. While the distension is being relieved the parietal wound may be sutured, and the knuckle of projecting bowel attached by a few points to the edges of the wound.

The peritonæal sac must be next cleansed of any fluids, and above all of any discharges, either by sponges introduced on large Spencer Wells's forceps down into the pelvis and along the costo-vertebral furrows, or by flushing with a hot solution of boracic acid (2 per cent.) or ⅕ per cent. of salicylic acid, in boiled water; pints of this being introduced by an irrigating tube. After the flushing, sponges are again used, and a Keith's tube inserted. Drainage is always to be employed when the peritonæal sac has been contaminated. Further details are given at p. 215.

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* I have recorded, pp. 226, 278, a case in which this treatment saved the life of a patient suffering from strangulation of the small intestine (localised gangrene having set in) by a band.

The opening in the abdominal walls is then closed with sutures of wire, or silk or fishing gut, material of sufficient stoutness being provided if any tension is present. Care should be taken to include the parietal peritonæum, and, as the sutures are inserted, to prevent any blood entering the cavity of the peritonæum.

B. **Late Cases.**—Here the condition of the patient will not allow of any but the briefest operation. A small incision, two inches long, is made in the median line below the umbilicus. On opening the peritonæum, two fingers are introduced and carefully feel for the most distended coil within reach, and bring this up into the incision. This must now be opened and an artificial anus formed as described below at p. 224.

It may happen that this plan will result in the opening of a coil above the obstruction, or that the obstructed portion of intestine is already gangrenous, and in either of these cases the result must be fatal. On the other hand, it may be urged that in these extreme cases, further interference would be almost certainly fatal, even though the obstruction were relieved, and, moreover, that the most distended coils of intestine usually rise to the surface and are situated close to the umbilicus; and, finally, that a few lives have certainly been saved by this means.

Having spoken of the operation generally, I shall next refer to a few practical points connected with the chief causes of obstruction individually.

I. Strangulation by Bands and through Apertures.[*]

A. **Bands.** 1. *Adventitious Peritonæal Bands.*—Perhaps there has been a history of peritonitis, starting possibly from the cæcum, the uterus and appendages, or a mesenteric gland. These bands are usually attached by one end to the mesentery. 2. *Omental Bands.*—Here some part of the lower end of the omentum has become adherent to the brim of the pelvis, a hernial sac, the uterine appendages, or the cæcum. 3. *Meckel's Diverticulum.*[†]—This is usually met with in young subjects. Tubular or cord-like, it will be found attached at one end to the ileum, within three feet of the cæcum, at the other near the umbilicus, or to the mesentery or intestine. Under this arch small intestine is very liable to slip. In other cases one end is free, and ensnares or knots up a loop of intestine. 4. *Some Normal Structure abnormally attached*, e.g., *the Fallopian Tube or the Appendix.*[‡]

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[*] Sir F. Treves (*Intest. Obstruct.*, p. 13; *Dict. of Surg.*, vol. ii. p. 802) groups these together from the similarity of their obstruction and their close resemblance to strangulated hernia.

[†] A most interesting and fully reported case successfully treated by laparotomy was published in the *Lancet*, March 9, 1889, by my old friend R. J. Pye-Smith, of Sheffield. Two others successfully treated in the same way by Mr. Clutton (*Clin. Soc. Trans.*, vol. xvii. p. 186) and Mr. McGill (*Brit Med. Journ.*, Jan. 14, 1888) will well repay reference.

[‡] One classification of bands useful to the operator is into those easily found and those which are inaccessible.

In most cases bands, when found, are not difficult to deal with. If they do not give way to the finger as attempts are made to hook them up, they should be divided between two ligatures of silk. Occasionally transfixion is required. When one band has been discovered, the possibility of a second, attached to the pelvic brim, must always be remembered. In Gibson's list of cases there are 186 of obstruction by bands, and in no less than thirty-three of these there was a record of more than one band being present, and it is probable that the proportion is even higher than this.

Two other points connected with bands must be remembered: one, that if they are vascular both ends should be secured; the other, that on the division of the band the piece of intestine which has been released may be found to be gangrenous or even perforated, and allowing its contents to escape into the peritonæal sac. The intestine must then be brought outside and drained, and the peritonæal sac cleansed if possible (p. 215).

Every band should be resected as closely to its attached points as is safe, to prevent any recurrence of the trouble. In the case of a diverticular band which is tubular, the contiguous peritonæal contents being all shut off with sponges or tampons, the diverticulum and the intestine into which it opens are emptied by pressure. Then the diverticulum, being lightly clamped, is divided, an inch and a half or two inches from the intestine, the mucous coat is disinfected with pure carbolic acid and tied with silk or sutured with a few silk sutures, while a second row, which takes up and inverts the muscular and serous coats, gives further security.

B. **Apertures and Slits.**—These may be congenital or traumatic. The two following cases are good instances, and show in sharp contrast the difficulties which may be met with:

In Mr. Howard Marsh's case (*Brit. Med. Journ.*, June 2, 1888) a loop, probably in the middle of the jejunum, had slipped through a hole in the mesentery. The edge of this opening was so yielding that Mr. Marsh could readily stretch it with his finger-nail sufficiently to allow the loop to be drawn out. The patient made a good recovery, though in much danger for a while from the paralysed condition of the intestine.

In Sir F. Treves's case (*Oper. Surg.*, vol. ii. p. 389) the intestine was strangulated in the foramen of Winslow. Here the surgeon not only could not reduce the gut by operation during life, but at the necropsy he could not bring about reduction until the hepatic artery, portal vein, and bile duct were severed.

In the case of either bands or apertures it is the lower part of the ileum which is usually strangulated.

II. **Intussusception.**—From its frequency, especially in early life, its fatality in infants, and the fact that its treatment is less unsatisfactory because its diagnosis* is easier than other forms of obstruction, this deserves careful notice. Of the varieties—the enteric, the colic, the ileo-colic, and the ileo-cæcal—the frequency of the last is well known. It is to this variety, especially in children, that the following remarks mainly apply.

The *treatment* depends upon the duration of symptoms. In quite early cases, reduction will generally be possible with comparatively little force, and may be brought about satisfactorily by injection or inflation. Very soon, however, the engorgement of the intussusceptum and the included mesentery, or the adhesion of the entering and returning layers as the result of peritonitis, renders reduction much more difficult or impossible. In such cases distension of the colon will either fail altogether, or will produce only partial reduction with subsequent speedy relapse. The following figures from Gibson's list (*loc. supra cit.*) will serve to emphasise this important point: 94 per cent. of the cases treated within the first twenty-four hours were reducible on abdominal section, whereas only 61 per cent. of those treated on the third day were reducible. The proportion reducible by *distension* would necessarily have been less than the above in each case.

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* Two points must always be remembered in the diagnosis of intussusception: (1) that in cases which are not acute there may be very few symptoms for some time; (2) the rectum must always be examined, and any intussusception which may be met with not mistaken for a prolapsus.

The following results of distension will also serve to emphasise the importance of attempting reduction by distension of the bowel in early cases only, and, moreover, show how fruitless the practice of repeating distension is likely to be after it has once been tried and has failed. Mr. Eve collected twenty-four cases from the records of the London Hospital in which distension was tried. Of these six died without further treatment, and the remaining eighteen required operation. Mr. Barker (*Clin. Soc. Trans.*, vol. xxxi.) tried distension in eight cases, in all of which it failed; and in a collection of cases by Wiggins, distension failed in 75 per cent. of seventy-two cases in which it was tried.

Moreover, the following *objections* to distension must not be lost sight of:—(1) The danger of sudden collapse or rupture of the bowel; (2) the loss of valuable time, rendering the result of a laparotomy less likely to be successful; (3) it will be of no use in enteric intussusceptions (which form 22 per cent. of all cases), and probably of no use in ileo-colic intussusceptions (which form 12 per cent.), so that in 34 per cent., or in one case in every three, it is practically certain to fail.

If the case is seen, therefore, within twenty-four hours of the onset of symptoms, distension of the bowel may be tried. Either water or air may be used for this purpose; of these the latter is to be preferred, as being less dangerous.

A little A.C.E. mixture being given, the lower limbs being somewhat raised, the nozzle of a Lund's inflator, or a full-sized catheter, or a rectal tube, attached by tubing to a bellows and well coated with vaseline, is carefully passed into the bowel. The nates being securely pressed round the tube, air is steadily pumped into the colon, while the surgeon keeps one hand on the abdomen, not only to prevent over-distension, but also to watch for any receding of the tumour towards the cæcal region.

With regard to the force used, Dr. Goodhart (*Dis. of Child.*, p. 125), remarks: "Replacement of the bowel can usually only be effected by considerable distension of the whole colon, and distension of the colon sometimes requires a good deal of rather forcible pumping to complete it." This is especially the case with regard to the last few quantities of air sent in. Dr. Taylor's advice here will minimise the risk of rupture of the bowel: "The risk can be reduced to a minimum by injecting, carefully and slowly, successive small quantities, and by gently kneading the abdomen so as to facilitate the passage of air upwards, and thus prevent the sudden over-distension of short lengths of the colon."

If inflation fails, and in all cases seen later than twenty-four hours after the onset of symptoms, abdominal section should be at once proceeded with.

Operation.—The child being under the influence of the A.C.E mixture, the parts being cleansed, and any urine drawn off, an incision is made, usually in the middle line,* sufficient to admit of the easy introduction of two or three fingers. Before opening the peritonæal sac all bleeding should be entirely arrested. The intussuscepted mass is now found, and, if possible, hooked out into the wound. But more often this is impossible, and the reduction must be effected *in situ*.

Prof. Senn advises (*loc. infra cit.*, p. 128) that: "The œdema and inflammatory swelling should be removed before any attempts at reduction are made. This can be readily accomplished by steady and uninterrupted manual compression of the invaginated portion." My own experience here is disappointing.

FIG. 44.

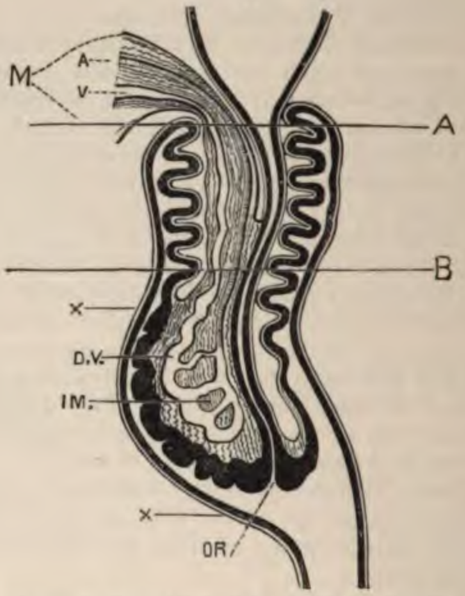

Diagram of an intussusception in vertical section.

M, Mesentery. A, Artery. V, Vein. D.V, Dilated vein. I.M, Inflamed mesentery. OR, Orifice of bowel at apex of intussusceptum with thickened mucous membrane around. A, Line drawn through usual seat of adhesions. B, Line for resection of intussusceptum. x, x, To mark the vertical incision through which resection is performed. (Greig Smith.)

The following points must now be carefully attended to. If the intussusception cannot be brought outside, two fingers of each hand should be introduced, and an attempt made (1) to draw out the intussusception while the point of entrance is held steadily. As a rule, this is only partially successful. (2) The lower end of the invaginated part being found, the ensheathing layer should be pulled down, while the ensheathed part is pushed up. When the end of the intussusception has reached the rectum, help may be given by an assistant with a bougie; but it will usually be found that pushing or backing-out the contained bowel by gently squeezing movements between the finger and thumb, these being gradually shifted along the gut, will prove successful, when, by no force that is justifiable, could any part be drawn out.

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* As speed is very important in these cases in children, the surgeon should give himself enough room by beginning above the umbilicus. The intussusception usually lies deeply and is difficult to get at.

Whichever method is found to answer best must be persevered with until every atom of the mass is reduced, this being often known by the appearance of the vermiform appendix.

If, when the reduction is complete, any tears are noticed in the peritonæal coat, these must be sewn up with a fine continuous silk suture, and a little iodoform rubbed in.

Every care should be taken throughout the operation to prevent chilling, both of the child's body and limbs, and especially of any intestine which may have to be withdrawn.

As in all abdominal sections, this operation should be concluded as speedily as may be.

When the intussusception cannot be reduced, all attempts at traction and kneading only causing tears in the peritonæal coat, the following courses are open according to the condition of the patient, &c.:—(1) If the intussusception is gangrenous but small in amount, it should be resected. For the union of the divided ends Murphy's button has the great advantage of saving time, and is thus well adapted to acute and subacute cases in children, which form the majority of the cases. Whatever method is used some difficulty must be expected in effecting exact union in the common variety, the ileo-cæcal, owing to the difference of the lumen in the two parts of the bowel; where this difficulty is very marked, the best plan will be to close both ends by a double row of sutures, continuous and Lembert's, and then to make a lateral anastomosis (*q.v.*) by means of Murphy's button, Robson's bobbin, &c. (2) If the invagination is irreducible but not gangrenous, it may be left, and the continuity of the canal restored by short-circuiting the small and large intestine above and below the invagination by Murphy's button or some other means. (3) Where the patient's condition is good, as in chronic cases, an irreducible intussusception is best treated by an operation based by Mr. Jessett (*Surg. Dis. of Stomach and Intestines*, p. 140) on what is known as spontaneous cure. It was three times performed successfully on dogs. An invagination having been made artificially, and found a week later firmly adherent, it was thus removed. A longitudinal opening was made into the intestine over the root of the intussusception on the side farthest from the mesentery, about an inch and a half long, of sufficient length to allow the invaginated part to be drawn out with vulsellum forceps. The root of the invaginated part having been pulled out through the above opening, was cut through close to its origin, any vessel which required it being tied. Then the divided coats where the intussusception had been cut away were united with a few points of suture, the lumen of the bowel being left open. The stump was then returned into the intestine, and the incision in this closed by quilt sutures. Greig Smith (*Abdom. Surg.*, p. 676) recommended this method of treatment, but modified the operation in cases of extensive invagination, in that, as will be seen by reference to Figs. 45 and 46, he removed only the apex of the intussusceptum, this being the most swollen part, and therefore the chief obstacle to reduction. The rest was then gently reduced. Although reduction will be rendered possible in some cases by removal of the apex of the intussusceptum, in others the adhesion of the layers at the neck of the intussusception, to one another, will make reduction impossible. In such cases, a more complete resection of the intussusceptum will be necessary. Other and less desirable methods which may be thrust on the surgeon, owing to the circumstances under which he operates, are: (4) Resection and formation of an artificial anus.* (5) Formation of an artificial anus without resection. Finally, in those rare cases of invagination of the colon into the rectum the intussusception may be drawn down and removed by the operations of Mikulicz, or Mr. Barker in this country. The latter surgeon's cases will be found in the *Med.-Chir. Trans.*, 1887, vol. lxx. p. 335, and *Brit. Med. Journ.*, vol. ii. 1892, p. 1226. In both cases a malignant growth was at the root of the invagination, and in each operation steps were facilitated by the ease with which the growth, after dilatation of the anus, could be pulled outside. Two rows of sutures were made to encircle the bowel, and to unite the two layers of the intussusception firmly together well above the new growth. As the

Fig. 45.

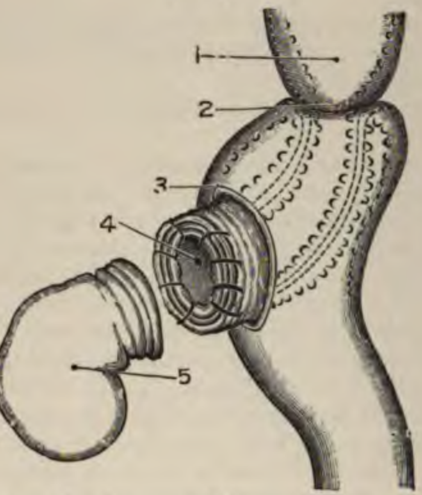
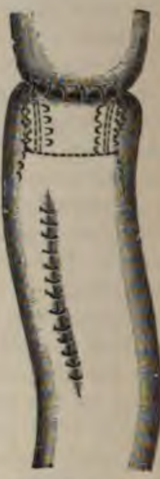


Diagram showing removal of apex of intussusceptum through an incision in the intussuscipiens.

1, Entering bowel. 2, Neck of intussuscipiens. 3, Incision in intussuscipiens. 4, Cut edges united by sutures. 5, Apex of intussusceptum excised. (Greig Smith.)

Fig. 46.



Operation of resection of intussusceptum completed. (Greig Smith.)

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* Prof. Senn quotes a case of Wassiljew's (*Centr. f. Chir.*, 1888, No. 12), in which an operation was performed to close the artificial anus six months later. It was ultimately successful.

sutures were passed, care was taken that no small intestines protruded. Both cases recovered, and the first was alive four or five years after the operation.

III. **Volvulus.**—The intestine here is usually either twisted on its mesenteric axis, or bent at an angle. The first is the acuter condition, owing to the strangulation of vessels. It is usually met with in the sigmoid flexure, when this has a long meso-colon, especially in adults who have been subject to constipation (Treves). The distension may be enormous, the sigmoid appearing to occupy the whole abdomen. Ulceration leading to fatal peritonitis may set in, either in the sigmoid, the colon, or the cæcum.

A free incision will be required here, so as to enable the surgeon to get at the root of the volvulus. The volvulus may present at once as a hugely distended coil; it may be felt as a localised collection of intestine; if twisted, the twist may feel like a band, and a band may actually complicate the case as when a vermiform appendix is coiled round the root of the twist of the volvulus (*Brit. Med. Journ.*, vol. ii. 1892, p. 170). If attempts at reduction fail, the volvulus should be drained by tapping or incising the summit of the loop, this being brought outside the peritonæal cavity. Fresh attempts at reduction are then made, and if they succeed, and if there is no tendency for the volvulus to reform, the opening is closed, and the intestine thoroughly cleansed and returned. If reduction is impossible, an artificial anus must be made immediately above the volvulus, this having been first completely emptied and closed.

In a very few cases where the volvulus is persistent or recurrent, and, at the same time, of small extent, it may be resected if the patient's condition admits of it. But volvuli of small extent can usually be reduced.

The following points are noteworthy in the diagnosis and treatment of volvulus. It is not uncommon for this form of obstruction to follow an injury,* some loop of bowel distended with fæces, and with a long mesentery probably becoming suddenly displaced and unable to recover itself. Again, this form of obstruction has been noticed, whether as a mere coincidence or not, in many cases in the insane. Finally, at the time of treatment, Sir F. Treves's warning (*Oper. Surg.*, vol. ii. p. 390) must always be remembered: "The reduction of a volvulus does not usually remove the anatomical condition that led to it." The truth of this is shown by their tendency to recur.

Thus the late Mr. Greig Smith (*Abdom. Surg.*, p. 450) described a case of volvulus of the small intestine which recurred a week after it had been untwisted by abdominal section. Enterotomy was then performed, and the patient for some time wore a catheter in the opening to allow of the passage of flatus into a bottle which he carried in his pocket. After some time the distended bowel had so contracted that the use of the catheter could be dispensed with. Dr. Finney reports (*Johns Hopkins Hosp. Bull.*, March 1893) a case of volvulus which involved the whole colon between the ileo-cæcal valve and the sigmoid; it was rectified by operation, and recurred nearly three years later. A second recovery followed.

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[*] See cases mentioned by Mr. Turner, Dr. F. Hawkins, and Mr. Stavely (*Lancet*, vol. ii. 1892, p. 995); a case successfully operated on by Mr. Silcock (*Clin. Soc. Trans.*, vol. xxviii. p. 180). References are made in the latter paper to eight successful cases operated on abroad.

Prof. Senn has advocated shortening the meso-colon to meet this tendency to recurrence. Fixation of the colon by two or three points of suture might be tried as less risky, if access is not prevented by distension of the small intestines. In any case, great care will be needed by such patients in their diet and to ensure efficient action of their bowels.

IV. **Gallstones, Intestinal Calculi, &c.**—Gallstones, the most common of these, present cases very favourable for operation if taken in time, owing to the simplicity of the cause of obstruction, and the facility with which it may be usually dealt with. Operation has been here too often deferred, owing to the fact that these patients, usually advanced in life, and stout, are not well suited to operation from a general point of view, and because it has been strongly insisted upon by some that if pain and spasm can only be removed, the local cause of the obstruction will pass on. This I believe to be a mistake. Sir F. Treves (*Intest. Obstruct.*, p. 335) states that of twenty cases in which gallstones "produced definite and severe symptoms of obstruction," six patients recovered by the spontaneous passage of the stone, and fourteen died unrelieved. It is to be hoped that the successful cases which have been published, one as long ago as 1887 (*Lancet*, Dec. 3), by Mr. T. Smith, Mr. Clutton (*Clin. Soc. Trans.*, vol. xxi. 1888, p. 99), and more lately by Mr. A. Lane (*ibid.* ii. 1894, p. 382), and Mr. Eve (*Clin. Soc. Trans.*, vol. xxv. 1895, p. 91),* may bear good fruit. In some cases, in addition to the age, stoutness, and habits of the patient, the history of previous inflammation in the neighbourhood of the gall-bladder may help the diagnosis; in four cases, certainly, the calculus has been felt—the abdomen being undistended—before operation. But in the majority it is probable that here, as elsewhere, operation alone will demonstrate the cause of the obstruction.

The following courses may be adopted: (1) To try and pass on the stone through the ileo-cæcal valve into the large intestine. Mr. Clutton (*Clin. Soc. Trans.*, vol. xxi. p. 99) succeeded in doing this, the stone being situated eight inches above the valve. But usually the stone is too firmly fixed.

Mr. Clutton's case is a very instructive one. The patient, a woman aged 70, was operated upon within twenty-four hours of the beginning of the attack. Fifteen months before she had passed a large facetted biliary calculus, and after her recovery from this had had a swelling in the region of the gall-bladder. This disappeared with the onset of the obstruction. A median incision four inches long having been made, the stone was readily felt, and though it tightly fitted the lumen of the intestine it could be forced along. As owing to the early date at which the operation was performed, there was no marked difference between the intestine above and below the obstruction, the site of the ileo-cæcal valve was determined by making out the cæcum and the appendix. There was not much difficulty in urging the calculus in the right direction, but as soon as the valve was reached some considerable force was required to make it pass through. This most successful case strongly supports Mr. Clutton's advocacy of an early operation, before the stone has become so immovable as to require opening of the intestine.

Dr. Maclagan (*ibid.*, p. 97) draws attention to an important point. If other stones exist in the gall-bladder or ducts, another may descend before the wound is healed, and, forcing its way through the recent incision, cause fatal peritonitis.

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* In this paper some thirty cases which have been treated by abdominal section are given and the result considered.

(2) If the stone does not feel very hard a cautious attempt may be made to crush it between flat-bladed forceps, guarded with drainage tube. Such a course can only be adopted when the intestine immediately adjacent to the stone is healthy. (3) The same precaution must be taken if Mr. Tait's suggestion of breaking up the stone with a needle is resorted to. If used, the needle must puncture obliquely, an inch and a half from the stone. (4) If the stone cannot be pushed onwards, and if it is too hard to be broken up, it must be removed. The loop being drawn well outside the peritonæal cavity, an incision must be made in the intestine opposite to the mesenteric border, the calculus removed, care being taken that its long axis corresponds with that of the wound and that the edges of this are not bruised. The wound is then closed most carefully with Lembert's or Halsted's sutures, silk being used. Whichever of the last three methods is resorted to, the stone must, if possible, first be pushed into an absolutely healthy part of the intestine, if that surrounding it is inflamed or thinned. (5) If the condition of the intestine is suspicious, or if, on opening it for the removal of the stone, the mucous coat is ulcerated, one of the three following courses must be followed, according to the condition of the patient and the resources of the operator, viz.: (*a*) Resection. (β) Formation of an artificial anus. (γ) Where the operator is doubtful if his sutures will hold, but desires to give this method a chance, he will suture the wound of extraction and then bring this outside, packed around with iodoform gauze for twenty-four or forty-eight hours, or leave it just within the abdominal wound, anchored here by a catgut stitch, and shut off from the rest of the peritonæal sac by tampons of iodoform gauze (wrung out of 1 in 20 carbolic-acid lotion), the ends of which are brought out through the parietal incision.

V. **Thrombosis of the Mesenteric Vessels or of Abdominal Aorta.** —Mention must be made of the above conditions, as it is clear, from the cases published, that, though rare, they may simulate acute intestinal obstruction very closely. The explanation appears to be that a loop of intestine, deprived of its blood-supply by an embolus, will, functionally, be as completely paralysed as if it had been strangled. Instructive cases of this kind will be found published by Mr. M'Carthy (*Lancet*, vol. i. 1890, p. 646) and Dr. Munro, of Middlesbrough (*ibid.*, vol. i. 1894, p. 147).

Dr Munro quotes from Gerhardt and Kussmaul the following diagnostic points of these cases: (1) A source of origin for the embolus; (2) profuse hæmorrhage from the bowels; (3) severe colic-like pains in the abdomen; (4) rapid reduction of temperature; (5) demonstration of an embolus in some of the other arteries; (6) palpation of infarcts in the mesenteries. In Dr. Munro's case, one of these, situated in the meso-sigmoid, could be felt, before operation, in the left iliac fossa. To these points might be added advanced age and no evidence of malignant disease. The mischief is usually too extensive to admit of surgical interference. If it be limited to the small intestine, several branches are usually plugged.

The recorded cases have almost invariably ended fatally. In one case, however, the portions of bowel and mesentery involved were removed with success.

Before closing the account of the surgical treatment of acute intestinal obstruction, I must allude to Prof. Senn's* advice to try insufflation with hydrogen, in order to find the seat of obstruction.

Prof. Senn, finding that distension of the entire gastro-intestinal canal (for, owing to distension of the cæcum, the ileo-cæcal valve is paralysed) in animals was never followed by any ill effects, has advised this (1) in reduction of intussusception, (2) in locating the obstruction during a laparotomy, (3) in detecting the site of gunshot or other perforations of the intestine. The gas is collected in a four-gallon rubber balloon, and the inflation made by compressing the balloon. A manometer or mercury gauge connects, by rubber tubing, the rectal tube on one side and the balloon on the other.

This method, though extremely ingenious, is likely to have but a limited application. In the reduction of intussusceptions the use of ordinary air is much more handy, and has been abundantly successful. In the detection of perforations, especially those by gunshot, the test has certainly answered, but the following ***risks*** are connected with its use. It will demonstrate perforations, but nothing else, and may lead the operator, if he trusts to it, to overlook many other lesions which may be as dangerous as perforations themselves. Many conditions—*e.g.*, impacted fæces, prolapse of mucous membrane, and recent adhesions—may interfere with its efficacy (Morton). Though aseptic when introduced, the gas can hardly be so after passing through many feet of intestine. It may break down most vital adhesions. It may increase, by the distension it causes, the danger of the anæsthetic, and is, of course, only available in cases where there is little, if any, distension.

APPENDICITIS.†

Before discussing the question of surgical interference here, it will be well to make plain what we mean when speaking later of **the varieties** of this disease. These are:

i. *Catarrhal and Early Interstitial Appendicitis.*—Here the inflammation is limited to the mucous membrane and the other coats of the appendix, but goes no farther (if the attacks be slight) than at the most a little plastic peritonitis and a few slight adhesions.

ii. *Appendicitis with a Localised Abscess.*

iii. *Acute Perforating and Gangrenous Appendicitis.*—Of these two, the first may at any time lead to a general peritonitis; the second, if left, always does so.

iv. *Relapsing or Recurrent Appendicitis.*

Question of Operative Interference in Acute Appendicitis.

WHEN TO OPERATE AND WHEN TO WAIT. TWO CAMPS OF OPINION.

One of us has already said, in a lecture elsewhere (W. H. A. Jacobson, *Polyclinic*, Dec. 1900), much of what follows concerning the present state of opinion on this subject.

"(*a*) *Advocates of Waiting and Watching.*

"Those who follow on these lines rely on the fact that the majority of cases of appendicitis recover under medical treatment. In other words, they represent that the dangerous forms in which sloughing or gangrene or perforation of the appendix with suppurative peritonitis, pylephlebitis, &c., follow, are but few. Dr. Hawkins, quite one of the highest authorities on the subject, puts the death-rate of appendicitis at 14 per cent., and hopes it may be reduced to 12 per cent.

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* *Loc. supra cit.*, p. 53; and *Journ. Amer. Med. Assoc.*, June 1888: "Rectal Insufflation of Hydrogen Gas an Infallible Test in the Diagnosis of Visceral Injury of the Gastro-intestinal Canal in Penetrating Wounds of the Abdomen."

† I use this term, etymologically unsatisfactory, because it is convenient and based on correct pathology.

"With all respect to Dr. Hawkins, I, myself, look upon the above estimate of 14 per cent. as too low, when hospital cases are considered. It is interesting to note that Dr. MacDougall, in his address at Carlisle in 1896, quoting from returns made from the Edinburgh Royal Infirmary for the three years 1893, 1894, and 1895, found that the death-rate of acute appendicitis was 25 per cent., and that the returns of two London Hospitals—St. Bartholomew's, 1893 to 1895, and St. Thomas's, 1892 to 1894—gave a death-rate of nearly 20 per cent., and it is doubtful if these returns included all the cases admitted of purulent peritonitis. . . .

"The advocates of waiting and watching further maintain that in the indiscriminating removal of appendices which they say has been going on in America, we have had an abuse of surgery similar to that which characterised, some years ago, the operation of oöphorectomy.

"(*b*) *The Advocates of Operation at Once, or at the End of Thirty-six or Forty-eight Hours.*

"Let us consider how this school, to which, I confess, I have felt myself drawn increasingly during the last few years, would answer the objections to early operation which I have just mentioned. And I will take the last first, viz., the criticism that this operation of early removal of the appendix has been abused, and the comparison between it and the similar abuse with which most of us are familiar as to oöphorectomy.

"There is an old saying that '*Abusus non tollit usum.*' A pendulum of opinion which sways strongly first in one direction, then in another, needs watching. And in my opinion there is a danger that in being influenced by the needless operations which have no doubt been done in America and elsewhere, we shall lose sight of the very sound and splendid work done by the best surgeons of that country. I shall allude to this more in detail shortly. I will only add that in this country hasty and needless operating will certainly not be the rule of treatment, but there is a risk that in priding ourselves on this, we err on the other side. I am certain that the results of the best American surgeons are far superior to anything in this country, and are but little known amongst us.

"With regard to the comparison between removal of the appendix and the ovary, I scarcely think this holds good. A diseased ovary may cripple, but it very rarely kills; it is not a vestigial structure; though unsound, it is not necessarily functionless. An appendix has not, like the ovary, peculiar importance not only to its owner, but also perhaps to others, an importance quite *sui generis*. The advocates of early operation would answer to the conservative school: 'You sanction, nay, perhaps you urge operation as soon as evidence of gangrene, perforation, suppurative peritonitis, or local abscess is certain. But by the time the evidence is sufficient for you to call in surgery it is often too late; you admit that it is usually impossible to diagnose such conditions as gangrene and perforation till the disaster is announced by evidence which is unmistakable, but which announces a condition in which surgical interference is too often useless.'

"The advocates of early operation claim that by operating early, and thus making sure that infection has not extended beyond the appendix, the surgical death-rate would be much below the medical one, which we have seen to be put by one of the best authorities at 14 per cent. Thus Dr. Morriss holds that the death-rate should not exceed 4 or 5 per cent. when cases of gangrene, perforation, and suppurative peritonitis are operated on, and goes so far as to say that a surgical death-rate of 2 per cent. in cases operated on early 'would be illegitimate.'

"Let us examine this claim that the medical death-rate will be much lowered by early surgical interference. It will be seen to stand or fall very largely upon the meaning of the word 'early.' The question at once arises, 'How many cases are really seen within the first twenty-four or thirty-six hours?' Certainly, I think but few in hospital practice. Here the patient very often goes on working for days after he has had warnings of pain, and even sometimes with a lump in his right iliac fossa. We must face the fact that it will be difficult to determine whether, with this word 'early' before us, we really are dealing with the first twenty-four or thirty-six hours. A patient, from carelessness or inaccuracy, or a desire to make the best of his case, from a dread of operation, may misrepresent his symptoms as just beginning. In reality this man had had, for a day or two, pain or other evidence that a catarrhal condition has been established, and thus the appendix epithelium has had time to become shed, and an infection-atrium has had the opportunity of forming before a medical man is asked to see the patient. Then, when the latter is called in, the pulse, temperature, pain, tenderness, and so forth betoken not the commencement of an attack as the patient represents, but a stage in which an actual abrasion is present, perhaps even that the peritonæum is becoming infected.

"Having mentioned this caution, we will suppose, for the sake of argument, that all cases are seen within a really early stage, viz., twenty-four hours. Is it certain that early operation at this stage will be largely successful? Let us examine the ground on which we stand. If we accept Dr. Hawkins's mortality of appendicitis treated medically as one of 14 per cent. from gangrene, perforation of the appendix, and suppurative peritonitis, in order to ensure a surgical mortality of 4 or 2 per cent.—though Dr. Morriss is inclined to look upon even the latter as 'illegitimate'—it is clear that we must operate *successfully* on ninety-six or ninety-eight cases of acute appendicitis in the early stage. This is a statement which there is no gainsaying, and it is one which at once makes a mind capable of weighing evidence very thoughtful. When one considers the conditions under which this early operation may have to be done, in a febrile patient with an infected, septic organ to be removed, with intestines very likely distended, and many other conditions present the very reverse of those which make an operation during the quiescent stage so successful, it is difficult to say how far the medical mortality of 14 per cent., or, perhaps more correctly, of 20 per cent., will be reduced, even if the surgery be always that of skilled hands. That it will be reduced by habitual earlier operation, and in the lifetime of some of us, I am certain; but I doubt if it will be brought below 8 per cent., when all the conditions and the different personal equations of the operators are weighed.

"But, here, it will be only just to examine some of the results gained by the best of those American surgeons who advocate early operation in every case. These results are not sufficiently known in this country.

"I will take only two of the more recent ones, viz., those of Dr. Mynter, of Niagara, and Dr. Morriss, of New York. Dr. Mynter (*Appendicitis*, p. 172), whose book emphatically bears the stamp of a candid and judicious worker, writing in 1897, had had thirteen cases, all of which had more or less total gangrene but yet without perforation. They *all* recovered by prompt operation and extirpation of the appendix. Two cases were operated on during the first day, five on the second day, two on the third day, three on the fourth day, and one on the seventh day. 'These cases,' he goes on to say, 'are most interesting, as giving conclusive evidence of the importance of operating before perforation has occurred. No one can doubt that perforation with profuse peritonitis would shortly have occurred, and that they all would have died under any other than surgical treatment.'

"Dr. Mynter operated on another group of twenty cases, all of which had gangrene with perforation of the appendix, and commencing or diffuse peritonitis. Five of these recovered, while fifteen died—thirteen of diffuse peritonitis, one of gangrene of the cæcum, and one of suppurating pylephlebitis after the peritonitis had disappeared. The five who recovered were operated on, in two cases on the first day, in two cases on the second day, and in one case on the third day. Of the fifteen who died, one was operated on during the second day, two on the third day, five on the fourth day, two on the fifth day, four on the sixth day, and one on the seventh day.

"Dr. Mynter adds: 'Comment seems unnecessary; all died if operated on later than the third day.'

"Dr. Morriss's cases (*Lectures on Appendicitis*, New York, 1895) are somewhat less carefully tabulated, but are most instructive.

"Of ninety-one cases of acute appendicitis *operated on early, in fifty-nine in which only the immediate vicinity of the appendix was infected, although many of these cases involved extensive operative work, there was no death in this series of fifty-nine cases.*

"In six cases of intense general septic peritonitis, with the whole abdominal cavity bathed in pus, *only one patient died.*

"In three cases with intense general septic peritonitis, not marked by the presence of pus, *only one died.*

"In twenty-three cases of the walled-off abscess form of appendicitis, the most varied complications were present. Five only of these died, but one of these deaths was from acute suppurative nephritis, a second from 'intestinal obstruction due to adhesions which could not be separated at the time of operation on account of the patient's condition,' and a third, already weak from several months' septicæmia due to an abscess overlooked before Dr. Morriss saw the case, died of a continuance of the septicæmia.

"This death-rate of seven in ninety-one cases testifies in no uncertain terms to the admirable care and skill which must have been exercised to attain such a result.

"Dr. Morriss is quite justified, after such success, in writing: 'I feel that the death-rate in 100 such cases as the list contains should not be more than 4 or 5 per cent., notwithstanding the fact that many of the cases were in a condition which seemed to prohibit interference.'

"It seems to me that even if this surgical death-rate of 4 or 5 per cent. were doubled, viz., 8 or 10 per cent., it would give a better result than the medical one of 14 or 20 per cent., and our duty would be clear.

"But the following cautions must be borne in mind:

"First, that we have here the results of especial experience of those who have had opportunities of acquiring especial skill. Dr. Mynter strikes a very important note when he emphasises the point that wherever the home surroundings are unfavourable, the well-regulated operating-room of a home or hospital is a *sine quâ non*.

"Secondly, it is never to be forgotten that these operations are always serious, often very difficult, and that they require good experience, efficient assistance, and efficient antiseptic precautions.

"Thirdly, in estimating the surgical death-rate, which I do not myself expect to be less than 6 or 8 per cent., when all the conditions under which this operation will be performed are taken into account, we must remember that in certain cases of appendicitis beginning very acutely the operation, however early, will not save life. I refer to cases where a general peritonitis sets in early, possibly within the first few hours of the case coming under notice. The explanation of these cases probably is that in some it is not really a first attack. The history given is unreliable, the appendix is already a damaged one, and either gangrene or a perforation of its unhealthy structures sets in quickly, with the result of a rapid general peritonitis. In others, the explanation is that the bacillary activity is, from the first, acute, the resisting power of the patient's tissues very poor, or that some minute point in the anatomy of the appendix, as the gaps between the fibres of the muscular roots (*vide supra*), facilitates rapid transit of the septic process. No one can tell how often the lives of our patients hang on such minute points.

"There is another of the points of dispute between the two camps to which I would ask your attention. The advocates of early operation maintain that many of the cures which are secured by medical treatment —we will call them 80 or 85 per cent.—are not permanent and complete cures when followed up; but that permanent mischief is left behind, sometimes slight, sometimes severe and dangerous; and that patients would be saved from the great annoyance and suffering of recurrent attacks and much waste of time if the appendix were removed in the first attack. The following is an interesting instance of how incomplete may be the cure of a case treated on medical lines, and of the thread on which such a patient's life may be hanging:

"A gentleman, aged 23, was sent to me in July, 1896, by Dr. Goodhart with the following history:—In 1895 he had had a severe attack of appendicitis, in which the temperature was for some days between 102° or 103°. Under medical treatment he made an apparently perfect recovery. In June 1896, while bowling for an eleven of the Zingari at Manchester, as he shot up to the crease he suddenly felt an acute pain and dropped to the ground. He was carried to an hotel in a state of collapse, and when the mischief had abated came into my hands, as I have said. There was the characteristic thickened knotty lump and tenderness at one small spot in the right iliac fossa. The appendix, when removed, showed a good deal of thickening in its distal half, but, save for the adhesion of one single tag of omentum at one spot, it struck me as being strangely free from adhesions, considering the severity of the two attacks. The patient made a good recovery, and is now growing and exporting that excellent dry sherry, 'Pando,' at Xeres. I happened, after the operation, to pass a probe down the lumen of the appendix, when, to my surprise, the blunt end passed, without the slightest force, through the walls at a spot exactly where the tag of omentum was adherent. Here the end of the probe could be seen just covered by a filmy layer of peritonæum only. The chief events of the illness and the very narrow escape of the patient stood out very clearly. In the first severe attack, with a temperature of 103°, the appendix had suffered very severely; no walling-off life-saving adhesions had formed, save the one, single and omental. As the patient was bowling his very best, the uplifted arm and rotation of the whole trunk upon one leg brought, by means of the latissimus dorsi, pectoralis major, and external oblique—all continuous with each other and with the muscles of the lower limb at Poupart's ligament—a violent strain upon the abdominal wall, and so upon the omental tag, causing a stretching here, and perhaps a minute tear, and thus the agonising pain and collapse which heralded the onset of the second attack.

"There is one other of the points of dispute between the two schools to which, as a surgeon, I must allude. By the opponents of routine early operation it has been objected that such a course would be followed by a large number of ventral herniæ. There is, no doubt, truth in this, for the incision will, in many cases, have to be free in order to find the appendix and to enable the surgeon to get his field of operation thoroughly isolated with gauze tampons; secondly, drainage will often be required.

"But a ventral hernia must weigh lightly against a saved life. To put this matter succinctly, it will be better for such a patient to be fitted with an abdominal belt than to be measured for his coffin."

Such is, I think, a fair expression of the two camps of opinion on this subject.

For my own part, then, I consider that any physician is justified in asking a surgeon who is skilled in abdominal surgery and who has the necessary aids, &c., to remove the appendix as soon as the diagnosis is made. Again, I hold very strongly that every physician is not only justified in asking, but bound to ask, a surgeon skilled in this branch of surgery to interfere at the earliest possible moment in certain cases—viz., where the evidence of appendicitis is from the first severe and progressive. Of the evidence, the most valuable points are marked pain, tenderness, and vomiting. Next in value to these I should place the temperature and pulse. These may be fallacious,* the temperature sometimes falling and perforation taking place a few hours later. Another guide to which I attach much importance is the early look of grave illness or anything approaching to the pinching of the "facies Hippocratica." Two other points of evidence which are of great importance, but which, it is to be hoped, the surgeon will be allowed to try and forestall, are a tendency for the abdominal wall to become fixed, and a tympanites spreading from the right iliac fossa.

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* In Mr. G. Barling's words (*Brit. Med. Journ.*, vol. i, 1895, p. 1135): "The temperature is an uncertain guide, and one only to be relied upon when confirmed by other phenomena. If it present the paradox of a falling temperature with a quickening pulse the improvement in the former would be a fallacious guide. . . . . The great point in recognising these cases is not to regard any one point as essential to diagnosis. It is desirable to dwell not too much on the absence of one particular feature, as upon the intensity of those which are present."

I should like to call attention to one other point to which I attach great importance, and that is, the position of the most marked tenderness, resistance, and swelling, if present. The more internal to McBurney's point this evidence is found, the greater the risk that perforation will light up a general peritonitis instead of one limited to the iliac fossa. We have learnt much of late years, from American writers (*e.g.*, Bryant and Fowler), of the importance of remembering the position of the appendix (*Ann. of Surg.*, vol. i. 1893, p. 164; vol. i. 1894, p. 12). It is clear that when the appendix is directed internally, not only is the risk of general suppurative peritonitis greater if the appendix perforate, but if a localised abscess form it is more likely to communicate with the pelvis, and perhaps open into the rectum or vagina; if adhesions form about it there is a greater risk of much more important structures being involved—viz., the iliac vessels, ureter, bladder, &c.—than if the appendix be directed downwards, when it may be only adherent to Poupart's ligament. Many other instances of the practical bearing of anatomy upon the different positions of the appendix will suggest themselves.

I will now allude more particularly to one sign which I have only mentioned above, viz., swelling. Although some degree of swelling is usually present in the right iliac region, it cannot be too strongly insisted upon that in cases of "fulminating" appendicitis there may be no swelling from first to last.* In a very few cases swelling is absent from the right iliac fossa, but present elsewhere owing to the appendix being misplaced. Thus, a very few cases of left-sided appendicitis have been recorded. Dr. Fowler (*Ann. of Surg.*, 1894, vol. i. p. 160) publishes a case in which there was marked tenderness in the direction of the gall-bladder. No appendix could be found in the usual place, as it lay behind the liver. Again, rectal examination may reveal a pelvic swelling.

It will be seen that the above opinion of mine, that any physician is justified in asking a surgeon skilled in this branch of surgery to operate in cases of appendicitis in the earliest stages, and that he is bound to do so where certain evidence just given points to probable rapid perforation, is not the same thing as sanctioning the removal of the appendix as a routine practice by anyone who thinks himself competent to do so. Considering the increasing tendency at the present day for surgery to be taken out of the hands of properly qualified surgeons, men with a *boná-fide* and lifelong hospital training, and for it to pass into the hands of those who have no such ripe experience, no such operative training, and who are occupied with other work and other claims not always running on smooth lines with aseptic surgery—considering this and its effects, any such wholesale and routine removal of the appendix would be attended with disastrous consequences.

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* Some cases mentioned by Dr. Tyson, of Folkestone, at one of the discussions on this subject at the Clinical Society (*Lancet*, vol. i. 1892, p. 424), form good instances of the truth of this. In three cases in which, after mild symptoms had lasted for three days, there was sudden collapse and death, there had been sickness and tenderness, but no swelling. Operation was performed in one case unsuccessfully. In all three suppurative peritonitis following perforation of the appendix was found.

Operative Interference in Acute Appendicitis with Abscess.—A few years ago there was a tendency to wait until the abscess was thought to be safe—*i.e.*, till it was walled in by adhesions, and generally till it showed signs of being adherent to the abdominal wall,—the reason given being that, if opened before, the risk was great that the peritonæal sac would become infected. On the other hand, it is clear that in waiting we run serious risks, for: (*a*) the abscess may rupture and burst into the peritonæal sac, especially if the patient is restless; (*b*) the pus will burrow, *e.g.*, into the pelvis, opening into the rectum or bladder, downwards under Poupart's ligament, or backwards and upwards to the loin, all these directions being influenced by the position in which the appendix was lying before the attack.

These risks being increasingly recognised, there is a greater tendency to try and find the pus early. The following is the best evidence as to the early existence of pus:—Persistence and increase of the symptoms, both local and general, after thirty-six to forty-eight hours; marked local resistance and tenderness;* a persistent and usually progressive swelling.† Later obvious points are the time-honoured ones of the hectic character of the temperature, œdema, fluctuation, and redness.

The question of resorting to the exploring needle must now be alluded to. This has been advocated by some American surgeons. Sir F. Treves (*loc. supra cit.*) strongly condemns it, as: (1) it is not free from risk, as the needle may be thrust into important parts; (2) it may tap an appendix distended with fœtid mucus, and, allowing some of this to escape, bring about a suppuration which was by no means inevitable; (3) an incision is more reliable.

Operation.—The skin having been shaved and cleansed, an incision three to four inches long is made, if there be no swelling,‡ much as for ligature of the external iliac, crossing McBurney's line and lying about one inch and a half above Poupart's ligament. The inner extremity should not open the deep epigastric vessels. The peritonæum having been reached, this is most carefully opened,§ all bleeding having been previously arrested. *The appearances* will now differ accordingly as the surgeon is operating to relieve the patient *of an abscess or of an appendix which is on the point of rupture.* The *second* condition will be taken first. There may be an entire absence of adhesions, the appendix being swollen, thickened, and rigid; or thickened and contracted at one spot, and dilated beyond, the "cystic"* form of appendix of some writers. There may be gangrenous patches at tip or base,† or the appendix, itself gangrenous, may be embedded in gangrenous adhesions.

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* This may be masked by unwisely given opium.

† The swelling may be very slight or difficult to detect from the rigidity of the abdominal walls and the flinching of the patient unless an anæsthetic be given.

‡ This incision is very greatly to be preferred to one in the linea semilunaris, and *à fortiori* to one in the linea alba, because it gives very much more direct access to the parts concerned. If one in the linea semilunaris be made it will be found that the outer edge of the wound often requires to be strenuously drawn aside to enable the surgeon to get at the appendix. This use of the retractor may lead to bruising of the wound. Again, if a surgeon working in the linea semilunaris needs, as is often the case, to come low down, the deep epigastric vessels must be divided.

§ If adherent intestine is present the incision must be extended so as to open a normal part of the peritonæal cavity.

The treatment of the appendix must vary with its condition and the state of the patient. It should always be removed if possible. The wound being well opened out and the adjacent peritonæal contents having been shut off with tampons of iodoform gauze, the appendix is separated, if possible, from any adhesions present, and dealt with according to one of the following methods. If gangrenous it should be cut away as near to the cæcum as is safe, and, if its coats here will not bear ligature and sutures, the stump must be disinfected with pure carbolic or nitric acid, and one end of a strip of iodoform gauze wrung out of carbolic acid lotion (1 to 20) placed in contact with the stump, and the other brought outside the abdomen, sufficient of the wound being left open for the renewal of this. Any adhesions that are sloughy or gangrenous, and that cannot be snipped away, should be scraped out with a sharp spoon, disinfected as far as possible in the same way as the stump, the healthy parts, lips of the wound, &c., being kept away from them by iodoform gauze.

When the appendix is inflamed and soft, but not actually gangrenous, it will be quite sufficient to trust to ligature with medium-sized sterilised silk, about three-quarters of an inch from the cæcum. If the state of the patient or the softened condition of the appendix prevent anything more being done, these measures will be found quite sufficient, if pure carbolic acid be applied to the mucous membrane on the stump so as to disinfect this. If the appendix, where cut through, be healthy or only thickened, one or other of the following methods may be adopted.

Mr. Barker (*Brit. Med. Journ.*, vol. i. 1895, p. 863) recommends the following method of double ligature as being simple and rapid. It is based on the fact that when the appendix is much thickened the mucous and sub-mucous coats can, after circular division of the other coats, be drawn out in an unbroken tube. The mesentery having been first transfixed, tied, and severed near the cæcum, the serous and muscular coats are divided circularly about three-quarters of an inch from the cæcum. The mucous and sub-mucous tube is now drawn out, and the outer coats having been stripped back, as in a circular amputation, towards the cæcum, the above-mentioned tube is tied close to its juncture with the cæcum with fine silk and cut off. It at once retracts, the outer tube is drawn down over it and tied with fine silk or gut. Another plan, which is equally rapid and satisfactory, is to ligature and remove the appendix close to the cæcum, then to invert the stump of the appendix into the cæcum by means of a circular purse-string suture, situated about a quarter of an inch from the stump, all round. This, when drawn tight and tied, inverts the stump of the appendix. However the appendix is removed, when it is severed, any escaping contents must be received on gauze, &c. The meso-appendix must always be looked to, its artery properly secured, and if its stump can be drawn over that of the appendix, this will suffice in place of any more elaborate methods. Where the surgeon is in doubt about dispensing with drainage and closing his wound entirely, the extent and severity of any infective process, and the completeness with which he has been able to disinfect the deeper parts of the wound, must aid in the decision. The safest course in doubtful cases will be to leave the wound partly open, provisional sutures being inserted and left loose, and gauze strips employed (*vide supra*).

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* This would seem *à fortiori* to be a very dangerous condition, for if the patient recover from one attack with a cystic condition, the appendix may give way at this weakened spot during the next attack.

† Dr. Fowler (*Ann. of Surg.*, vol. i. 1894, p. 332) had the great good fortune to open the peritonæal cavity after the appendix had perforated, but before any of its contents had escaped. "The appendix, absolutely free from adhesions, was swollen to the size of a little finger, and perforated in two places. These were minute openings, through which soft fæcal matter oozed as the ligature was tightened about the base of the organ preliminary to its excision." The patient made a good recovery.

We next have to consider *the different conditions met with when*, on opening the peritonæum, *an abscess is present*, and the best means of dealing with them.

In those cases—and they form a large number—where the abscess is made additionally safe by becoming adherent to the abdominal wall, the surgeon will have a hint given him of the presence of this condition by the oozing and inflammatory matting of the deeper layers as he divides them.

We will suppose a more difficult case with no such tendency of the abscess to come forward through the abdominal wall. When the peritonæum is carefully divided the structure which most probably first presents itself will be the omentum matted down into the iliac fossa, perhaps adherent to the ileum, cæcum, or the neighbourhood of Poupart's ligament. This being separated off, or secured and divided in several pieces, a mass is found which consists of small intestine, cæcum, and appendix. Before this is dealt with it must be shut off from the rest of the peritonæal cavity by tampons of sterile gauze. The operator then endeavours to find any evidence of a longitudinal band which will denote the cæcum and may lead to the appendix itself. If he find one or more coils of intestine he gently separates one from the other, or turns the whole mass upwards carefully from the fossa, and, while doing so, probably gives rise to an escape of pus. Perhaps the site of this may be recognised by a yellowish sloughing spot. The pus is carefully mopped away as fast as it escapes. If large in amount the patient must be turned on to his right side to expedite the flow and preserve the peritonæal cavity from contamination.

In a patient sent to me by Dr. Dakin, after tying off a sheet of omentum, a large mass appeared in which I could not differentiate large or small intestine. No appendix could be seen or felt. On gently turning up the whole mass a sloughing spot was seen below, from which a blunt-pointed director gave vent to two drachms of pus. Pressure on the mass was now made, but no more pus escaped, and as no stercolith could be detected, a gauze drain being inserted down to the spot, I closed the rest of the wound by three layers of buried sutures (*vide infra*). A good recovery followed, and the patient has been able again to take briefs at assizes.

The greater part of the pus having escaped, the question of irrigation arises. It will probably be safer to trust to drying out the cavity with gauze on holders, and gently running in iodoform emulsion. Anything like forcible syringing or irrigation is to be condemned for fear of washing infective particles where they might set up a general peritonitis.

The cavity being cleansed as thoroughly as possible, the important question arises as to whether the appendix should be removed or not. The majority of surgeons consider that this should be done only when the appendix lies practically free within the abscess cavity, and should not be attempted where it enters into the formation of the wall of the abscess, or when it cannot be removed without separating adhesions on account of the risk of infecting fresh areas of peritonæum in the attempt, and the danger of prolonging the operation in these cases. The remnant of the appendix, if left, moreover, will very probably give rise to no further trouble; and if, owing to the persistence of a sinus or to later attacks of inflammation, its subsequent removal should become necessary, this can be done under much more favourable conditions. Some surgeons, on the other hand, make a great point of removing the appendix in every case; Dr. O'Conor, of Buenos Ayres, for instance, says (*Glasgow Med. Journ.*, Sept. 1899): "I made it a rule, some years ago, never to quit the abdomen, when operating for appendicitis, without taking the appendix with me." Mr. Lockwood also (*Appendicitis*, 1901) considers "that it is better for the patient to take the immediate risk of a determined attempt to excise the appendix; but how far the attempt should be carried must depend upon the peculiarities of each case"; and he quotes several cases where subsequent trouble arose from leaving an infected appendix.

Although recurrence and other troubles do undoubtedly sometimes arise when the appendix is left, the proportion of cases in which they occur is certainly comparatively small—Mr. Lockwood puts it at 15 per cent.—and therefore hardly justifies the greatly increased risk of the primary operation if the appendix is removed in every case. The appendix, therefore, should be removed, if this is possible without greatly increasing the risk of the operation; but where it forms part of the abscess wall, or where it cannot be found after a reasonable search, the wiser and safer plan will be to leave it. When found free in the abscess cavity, a transfixion of the base of the mesentery with an aneurysm-needle carrying a loop of silk, one-half of which is thrown round the appendix and the other round the mesentery, the ends cut short and the appendix and its mesentery amputated just beyond the ligature, will probably be found sufficient. Any projection of the mucous coat should be disinfected (p. 196). Whether it be removed or no, if a perforation be present, search should be made for a possible stercolith, as a fistula may follow for some time if one of these be left behind.

In those cases where pus has been present, the wound should only be closed in part, a drainage-tube being inserted and iodoform gauze strips packed around it, to replace the soiled ones which were inserted at first. Provisional sutures should be passed in the margin of the part not closed, to be tightened up as the tampons are removed.

The more reason that the operator has to be doubtful whether he has entirely cleansed the abscess cavity, the more thoroughly will he use such antiseptics as glutol, iodoform, iodoform emulsion, or, in cases that are very foul or accompanied by oozing, turpentine.

Any gauze tampons which have been used in the treatment of this or the next variety around the drainage-tube, or packed amongst loops of intestine where these have been in contact with pus, or subjected to much exposure or handling, should be removed, in part at least, on the first or second day. The object of the gauze is to keep surfaces free from sources of sepsis, to immobilise damaged parts, and to drain by capillary attraction. But the longer it is left the more firmly does it adhere, and the more does its removal cause pain and bleeding. In some cases it will be judicious to administer gas when the bulk of the gauze is removed.

Operative Interference in Suppurative Peritonitis.—The perforation here is due either to the acuteness of an infective process, to the pressure of a stercolith, to both combined, or to the rupture of a collection of pus. It is important to bear in mind these, the chief causes, as the evidence, both before and later, may vary somewhat. Thus, suppurative peritonitis may come on without the preliminary warning of a swelling (p. 194), as when the peritonitis is not preceded by an abscess. Again, when the rupture of an abscess is the cause of the peritonitis the characteristic symptoms of collapse will be more marked.

The warning[*] symptoms will be chiefly those given at p. 193—viz., a case often severe at first and progressively so, severe pain, marked local tenderness, rigidity, perhaps a swelling, tympanites spreading from the iliac fossa, early immobility of the diaphragm and abdomen, obstinate vomiting, early and persistently rapid pulse, and a high temperature.[†] Later on, marked distension, absence of any peristaltic movement, constant vomiting of the effortless regurgitation type, a pulse increasing in quickness and failing in strength, the drawn-up knees, and the facies Hippocratica—all these are time-honoured evidence which will show that while surgical interference may be right, it will probably be futile.[‡]

Operation.—The question here arises whether one or two incisions are to be made—viz., one over the iliac fossa, and a median one as well. If there is well-marked evidence of general suppurative peritonitis, and if the patient's condition will only admit of one incision, probably the median will be best, as giving more general access to the peritonæal sac, and perhaps admitting also, by free retraction, of getting at the vicinity of the appendix proper. The median incision has also the advantage of enabling the surgeon to see how far the peritonitis is general, for it must be remembered that irrigation, especially when carried out vigorously and thoroughly, may easily carry infective products to parts hitherto uncontaminated. But when the case admits of it the iliac region should always be explored first. Even if general, the peritonitis is certain to be severer here, septic products more abundant, and prolonged drainage more required. Moreover, the removal of a perforated or gangrenous appendix will be much simpler through an iliac incision.

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[*] Dr. D. B. Lees's cases (*Clin. Soc. Trans.*, vol. xxv. p. 135) show that a perforation communicating with the peritonæal sac, as long as this is shut off, does not give rise to collapse, and that the pain, tenderness, &c., may be so comparatively slight as to make it appear that operative interference is hardly justifiable. Yet under these circumstances the delay of a few hours may be fatal.

[†] Too much attention is not to be paid to these. In Dr. Fowler's words (*Ann. of Surg.*, vol. i. 1894, p. 153), "A lowering temperature and a lessening pulse-rate are not inconsistent with impending ulceration, perforation of the appendix into an unprotected peritonæal cavity, complete gangrene of the organ, or rupture of an appendicular abscess into the cavity of the peritonæum."

[‡] Dr. Gerster (*Ann. of Surg.*, vol. ii. 1893, p. 46) shows that in a few of these cases a stage has been reached in which recovery can only take place by letting them alone. Thus, in two cases of his, which were at death's door, perforation into the rectum occurred without any of the shock which an anæsthetic and operation would have caused, and recovery followed. If a bi-manual examination reveals a fluctuating mass in the pelvis, an incision should be made here.

The median incision is made, the edges widely retracted, and the extent of the infection made out. If any region appears to be free, this should be shut off as far as may be by tampons of iodoform gauze, or by suturing the omentum to the cut edge of the parietal peritonæum of that side. The pus present is then got rid of by swabbing out with sterilised gauze or iodoform gauze wrung out of hot salt solution; adherent coils are separated, most carefully drawn out and cleansed. The question of irrigation will now arise. When the pus is evidently diffused, when it is very foul, when the adhesions are few or absent, this may be employed. Boiled water or saline solution, at a temperature of 105° F., is preferable to lotions of mercury perchloride and carbolic acid, being less irritating. Whether irrigation or sponging out is trusted to, the condition of the lumbar pouches and the pelvis must be sedulously attended to. The last named must be drained by a glass tube.*

The iliac fossa is next examined, the appendix found, if possible, and removed according to the directions given at p. 196. Disinfection (p. 215) is again carried out by swabbing with gauze, or irrigation, and the part drained. In either case, if no special apparatus is at hand, the irrigating fluid can be conducted within the abdomen by a sterilised drainage-tube, arranged from a basin, like an ordinary syphon. Attached to this should be a glass tube, or a new large catheter, sterilised. The elevation of the tubing will regulate the force of the stream. To aid in the removal of pus, the intestines are gently moved to and fro by the fingers, and this may further be promoted by gently squeezing and kneading the abdominal walls. If there be time, any excess of fluid left after irrigation is removed by sponges on forceps. Drainage is provided from both openings, as above directed, provisional sutures being inserted. In some cases it may give an additional chance to drain from one loin by counter-puncture. After irrigation a glass tube must always be placed in Douglas's pouch (p. 217).

Operative Interference in Relapsing Appendicitis.—On this subject the profession owes its lead and the most instructive of its information to Sir F. Treves, who first proposed the removal of the appendix, during a quiescent period, in 1877, in a paper read before the Medico-Chirurgical Society.†

One or more of the following *conditions*, given by Sir F. Treves, will be accepted by all as *justifying operation*:—(1) The attacks have been very numerous. (2) They are increasing in frequency. (3) The last has been so severe as to place the patient's life in considerable danger. (4) The constant relapses have reduced the patient to the condition of a chronic invalid, and rendered him unfit to follow any occupation. (5) Owing to the persistence of certain local symptoms during the quiescent period, there is a probability that a collection of pus exists in or about the appendix.

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* Of these I prefer one known as Chamberlen's. It has one end rounded, suitable for resting against inflamed peritonæal surfaces, and the other drawn out and narrowed, so that a drainage-tube for sucking out is readily fastened on. But where concrete masses of fine pus and lymph are present, the large open end of a Keith's tube is preferable.

† The most valuable contributions of this surgeon are his *Treatment of Typhlitis*, 1888 and 1889; *Brit. Med. Journ.*, vol. i. 1893, p. 835, and vol. i. 1895, p. 517. In America, Dr. H. Mynter, following on the lines of the late Dr. G. Buck, was one of the earliest to advocate operative steps in certain cases of appendicitis, especially those accompanied by perforation (*Buffalo Med. Journ.*, 1879, p. 122).

Operation.—This is performed on the same lines as those given at p. 195. The details will vary with each case.

"Some of the cases have been most trifling. On the other hand, in two instances I failed to remove the appendix after very persistent attempts. It is impossible to predict beforehand the features of the operation. The attacks may have been violent and numerous, and the removal of the diseased process nevertheless prove to be a mere trifle. On the contrary, some of the most difficult operations I have met with have been cases in which I had hoped, from the history of the attacks, to have encountered no complications." (Treves.)

The skin having been carefully cleansed, an oblique incision is made about four inches long and crossing McBurney's line* about an inch and a half above the anterior superior spine. The aponeurosis of the external oblique is divided in the direction of its fibres, which practically corresponds to the line of the skin incision, the small piece of external oblique muscle being split, also in the direction of its fibres. The internal oblique and transversalis muscles, which run in a direction almost at right angles to that of the skin incision, are now likewise split in the direction of their fibres and well retracted. By making the abdominal incision in this way, as described by McBurney (*Ann. of Surg.*, vol. xx. p. 38), the weakening of the abdominal wall which necessarily results from free transverse division of muscular fibres is avoided, and the tendency to subsequent ventral hernia thereby greatly diminished. Although the amount of room obtained to work in by this method is somewhat lessened, and the difficulty of the operation to some extent increased, the advantage gained is so distinct that it should be adopted wherever possible. The greatest care must now be exercised, as the cæcum may be adherent to the peritonæum. If any difficulty is experienced the incision should be prolonged until it is certain that the peritonæal sac is opened. Any omentum that is present, adherent or thickened, should be removed. The appendix is now identified. This may be easy or difficult, from the structure being embedded in adhesions, lying under a cæcum itself fixed by adhesions, or tied down in one of the loculi which Mr. Lockwood has described. When it is found, its removal may be rendered difficult or impossible by the density of its adhesions, or by the important structures which these have implicated. Thus, Sir F. Treves, in the thirty-two cases which he has published, has found it adherent to the ureter, internal iliac artery, bladder, and ileum. In the thirteen cases on which I have operated, I was fortunate in only having to deal with adhesions to the cæcum, both to the cæcum and one of Mr. Lockwood's loculi, and posterior aspect of Poupart's ligament.

The following, one of the two cases in which Sir F. Treves found it impossible to remove the appendix, gives a good idea of the difficulties which may be present.

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* This may have to be modified according to the position of the swelling.

> "For a considerable time I was unable to demonstrate the abdominal cavity, owing to the adhesions. The cæcum was completely buried in a dense mass of adhesions, and here was hidden, no doubt, the appendix. I was not disposed to undertake the serious risk of opening up this area, especially as the adhesions obliterated both the ureter and the iliac veins, structures in no little risk of being wounded in these operations." The patient remained free from attacks up to the date of the case being published. six months after the operation.

When the area in which the surgeon is going to find or separate the appendix is defined, it should be shut off with iodoform gauze tampons or flat sponges. Where possible, adhesions should be cut with blunt-pointed scissors; where soft, or where the surgeon is in doubt as to their nature, they must be very carefully torn through with a fine-pointed blunt dissector. Where this separation of adhesions has opened the cæcum or ileum, these must be carefully closed with Lembert's sutures (p. 229). Where it is quite impossible to separate the appendix from such structures as the bladder, iliac vessels, ileum, &c., Sir F. Treves recommends division of the appendix as near to the cæcum as is safe, and then paring down the part adherent to the dangerous viscus until it is reduced to a mere disc. The actual removal of the appendix is carried out by one of the different methods given at p. 196. When any area has been unavoidably denuded of its peritonæal covering, the edges of this must as far as possible be drawn together, or an omental flap applied. If this be impossible, iodoform should be rubbed in; and if the part is intestine and weakened, iodoform strips should be used to shut it off and drain it, as directed at p. 198. If there is free and persistent oozing as the result of separation of adhesions, a gauze tampon should be packed down on to the bleeding surface and left in place for twenty-four hours.

To minimise as far as possible the risk of hernia, especially in young subjects with an active life before them, the wound in the abdominal wall should be carefully sutured. The peritonæum, internal oblique and transversalis, the aponeurosis of the external oblique, each of these three layers should be united with a separate row of buried sutures of chromic gut or silk, and then the skin with salmon-gut. If drainage has been employed, provisional sutures should be inserted.

Complications of Appendicitis.—Owing to the frequency of the disease and of operations for it, it will be well to bear in mind the chief complications which may accompany the severer cases, and operations for their relief. A mere enumeration must suffice. (1) Intestinal obstruction. This may be due (*a*) to paralysis of the intestines from septic peritonitis; (*b*) to adhesions about the appendix; (*c*) to its becoming adherent to some piece of intestine, mesentery, &c., and so incarcerating and strangling a loop of bowel. (2) Fistula.* This may be (*a*) mucous, or (*b*) fæcal. It may be due to incomplete closure of the appendix, to the leaving behind of a stercolith, or to giving way of the cæcum or ileum. (3) Hepatic abscess. (4) Empyema, or (5) Purulent pericarditis. Dr. Fowler shows (*loc. supra cit.*) that pus in the liver will tend to involve the diaphragm, and so bring about the last two conditions. I should have thought a simpler explanation was a collection burrowing upwards along the psoas. I have had one such case of right-sided empyema. The patient, aged 53, made a good, though very slow, recovery, chiefly due to the devoted attention of his dresser, Mr. Anderson. (6) Suppuration in the loin and about the kidney. (7) Suppuration in the pelvis. An exceptionally long appendix may dip into the pelvis and bring about the above. A case of this kind is given by Fowler. It was successfully treated by abdominal section. (8) Phlebitis of iliac veins. Fowler gives a case in which the appendicitis being gangrenous brought about ulceration and fatal hæmorrhage. (9) Appendicitis in a hernial sac. Fowler mentions a case reported by Dr. Rand, of Brooklyn, in which an irreducible femoral hernia became the site of inflammation due to an inflamed appendix which it contained. Sir F. Treves met with a case in which the appendix, the seat of recurrent trouble, occupied an inguinal sac. (10) Communication with the rectum, bladder, or vagina. (11) Septicæmia. This may supervene, as on one of the last-mentioned complications, quite apart from suppurative peritonitis. (12) Abscess in the abdominal wall, causing most extensive burrowing. (13) Stitch sinus. (14) Ventral hernia. (15) Thrombosis of the femoral vein. Dr. Meyer describes two cases of this (*Ann. of Surg.*, May, 1901).

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* Treves' *Surgical Treatment of Typhlitis*, p. 45. Mr. Southam has published (*Lancet*, vol. ii. 1892, p. 835) a case successfully treated by short-circuiting the intestine. Senn's plates were used.

PERFORATION OF GASTRIC ULCER.*

The perforation may either be *acute*, associated with sudden escape of gastric contents into the general peritonæal cavity, or *chronic*, resulting in the formation of a localised abscess.

A. **Acute Perforation.**—The successful treatment of these most fatal lesions depends upon early operation.

This should be performed as soon as possible after the accident, delay only leading to the additional escape of septic material, especially if the patient has been moved about. Another urgent reason for early operation is the fact that the later the operation is deferred, the more difficult it is, and the less is the patient able to bear the necessarily prolonged interference. Again, the longer the delay, the greater is the tendency to the formation of masses of lymph, which may conceal the ulcer, mat viscera together, and so form culture-pools for bacteria, and hamper the attempts at cleansing the peritonæum.

While the surgeon will be unwilling to interfere during the period of collapse which follows on the perforation, he should utilise this time in making the needful preparations.†

It seems clear that while ulcers occur most frequently on the posterior surface of the stomach, those on the anterior surface are most liable to perforate. Thus, out of ninety cases operated upon, the perforation in eighty-six was on the anterior surface; posterior perforations occurring only in eleven cases. Perforations are more frequently nearer the lesser than the greater curvature, and the cardia than the pylorus. This last fact is one of much practical importance, as the cardia is a relatively fixed point, and the nearer an ulcer is to this end, the greater is the difficulty in suturing it. Finally, it should be remembered that in several cases there have been more than one perforation. Finney (*Ann. of Surg.*, July 1900) says that in 20 per cent. of the cases there is a second perforation.

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* This is placed here instead of under the Operations on the Stomach, first, because, like a perforated vermiform appendix, it is such a dangerous source of peritonitis; secondly, because it calls for the same treatment as the less common duodenal ulcer.

† A hot-water table, water-bed, and hot bottles should be provided, the patient's limbs bandaged in cotton-wool, the head kept low, ether given, and an enema of port wine administered: injections of strychnine and the necessaries for saline infusion should also be at hand.

The operation itself includes: i. Finding the perforation; ii. Successfully closing it; iii. Efficiently cleansing and draining the peritonæal sac—headings which will be taken separately.

Operation.—The parts having been fitly cleansed, and every precaution taken against shock, an incision four to five inches long is made in the middle line from the tip of the xiphoid cartilage to the umbilicus. When the peritonæum is opened an escape of gas is not uncommon;* sometimes of fluid, consisting partly of the last meal taken,† and partly of serous effusion from the irritation of the peritonæum.

If there is no such escape the outlook is so far more favourable, as it may be hoped that as yet the effusion is slight, and limited to part only of the peritonæal sac. If this be so, though it is uncommon, the surgeon should shut off the lower part of this sac as far as possible with gauze tampons or flat sponges before he disturbs the stomach and its surroundings.

i. **Finding the Perforation.**—This varies very much in difficulty. Sometimes the eye detects it at once when the stomach is drawn down (by gently pulling on the omentum, if need be) and the edges of the wound retracted. At other times the exploring finger soon feels it or the area of induration which forms the base of the ulcer. In other cases finding the ulcer is beset with the greatest difficulty, or, owing to the hurried search which alone is possible from the state of the patient, is quite impossible. In a difficult case help may be obtained by tracing the direction in which the congestion of the stomach appears to be increasing, by watching the direction from which any flow that may be present is coming, or, acting on a suggestion which has been made of injecting air through an œsophageal tube, that the escaping bubbles may lead to the ulcer. If a careful search over the anterior surface of the stomach fail, the liver should be raised by an assistant, and the lesser curvature examined with a good light. Adherent lymph or adhesions between the stomach and liver may mark the site of the perforation, and require gentle separation before it is revealed. The perforation itself may be extremely small, and thus easily hidden by any fold of the stomach, still more readily by lymph and adhesions.

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* If it is a late case, as in one I mention (p. 208), the tympanites and distended intestines may be most embarrassing. In one published by Dr. Anson (*Lancet*, vol. i. 1893, p. 469), the distension all subsided after a rush of odourless gas when the abdomen was opened.

† The interval that has elapsed is most important. Thus, in a successful case published by Dr. Walter, of Reading (*Lancet*, vol. i. 1895, p. 484), five hours had elapsed. So, too, in a case of Dr. W. Hall's (*Brit. Med. Journ.*, vol. i. 1892, p. 64) which recovered without operation after very severe peritonitis, the interval was four hours.

Mr. Dunn's case (*loc. infra cit.*) well shows how difficulty here is to be met:

> On separating the adhesions which fixed the liver to the abdominal wall, a quantity of opalescent fluid escaped. The liver was then pulled upwards and the anterior wall of the stomach pushed backwards, and now it was that some brownish fluid like weak coffee, containing gas-bubbles and one or two small masses of coagulated milk, escaped. It welled up from a considerable depth, at the left of the incision, and was found, on subsequent examination, to be strongly acid, and to contain a little albumen. Several more adhesions were broken down, but still no perforation could be seen, and it was only when the left margin of the wound was stretched outwards to the utmost, whilst steady traction was made upon the stomach towards the right, that the hole in this viscus became visible.

At this stage, or a little later, to facilitate the suturing, it may be necessary to divide the left rectus, in order to get more room. Save for weakening the abdominal wall this step is a light one, as long as the intestines are not distended. If distension is present it is a serious complication, as it facilitates very much the escape of the intestines.

ii. **Closure of the Perforation.**—It has been suggested that, before this is done, the stomach should be emptied and washed out. If the perforation has been quickly found, if the patient's condition is good, and if the stomach can be got well outside the wound, emptying by gentle squeezing will be beneficial, by preventing vomiting, and thus a strain on the sutures. So, too, with regard to washing out the viscus, if a drainage-tube can be readily inserted through the perforation. But the small size of the external opening will often prevent this; and with regard both to emptying and washing out the stomach, it is certain that in neither case will the advantages gained counterbalance the loss of time, that would have been better spent later on, in thoroughly washing out the peritonæal cavity.

With regard to *excising the ulcer*, which has been recommended, the same conditions and objections apply. Much extra time will be consumed, there may be a good deal of additional hæmorrhage, and the perforation converted into a large gap requiring numerous sutures to close it (Swain, *Lancet*, vol. ii. 1894, p. 22). In this case much difficulty was met in inverting the pouting mucous coat. Moreover, the successful cases treated by suture without excision show that this step is not needful. If the perforation is spilling its contents when seen, a finger or sponge in a holder should be placed upon it, or a silk suture passed across its centre so as to prevent further escape. The perforation, having been shut off with iodoform gauze tampons, it is next carefully closed with Lembert's sutures of sterilised silk.* One row of these will suffice if inserted with the following precautions: They should begin and end well beyond the extremities of the perforation (Fig. 55). They should take up the coats of the stomach as far as, but not beyond, the submucous layer. They should be inserted far enough from the margins of the perforation to ensure sufficient inversion of the serous surfaces when the sutures are tightened, and this inversion may be aided by a probe or director. All the sutures should be inserted before any are tied. If any cut out as they are fastened, fresh ones must be re-inserted at a sufficient distance from the margins of the perforation to give a firm hold, and a second set must be employed where the union is certainly weak.

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* The passage of these may be facilitated by the use of two guide-stitches of medium-sized silk, passed a full inch from the edges of the perforation, as used by Mr. Gould in his case.

Whenever it is feasible the suturing should be performed with the viscus outside the wound, this part of the stomach resting on hot carbolised towels or tampons of sterile gauze.* When it is not possible to bring the stomach outside, the difficulties are greatly increased, especially if the perforation be near the cardia, a more fixed part. Here, drawing up the margin of the ribs and liver, pulling down the stomach, or division of the left rectus may be of service.

Where either the position of the ulcer or the amount of surrounding induration makes it impossible to close a perforation with sutures, one of the following courses should be followed: (1) A piece of omentum may be used to close the opening, being kept in position by means of careful suturing. (2) If the ulcer lies under cover of the liver it may be possible to fix this down, over the perforation, by means of sutures. (3) A closely fitting drainage-tube should be passed into the perforation to draw off all remaining food and secretion, and then the space between the stomach and the abdominal wall should be closed all around the tube with strips of iodoform gauze, so as to promote adhesions. (4) A less satisfactory plan is to stitch the margins of the perforation to the edges of the wound in the abdominal wall and treat it as a gastric fistula, the rest of the wound being firmly closed round it.

So far I have spoken of *ulcers on the anterior surface of the stomach.* The rarer but much less accessible ones on the *posterior* surface must now be referred to. As is well known, while gastric ulcers are much more frequently met with on this surface, these rarely perforate, owing to the tendency for adhesions to form between this surface of the stomach and the pancreas. If the evidence of perforation is strong, and nothing can be found on the anterior surface or lesser curvature, the surgeon can examine the posterior wall by (*a*) carefully tearing through the lesser omentum and inverting the anterior wall; the posterior one comes into view through the hole made in the lesser omentum ;† (*b*) by tearing through the great omentum, (*c*) by passing the finger through the foramen of Winslow.

In a case, under the care of Dr. L. E. Shaw, I adopted the first of the above plans. The operation was performed seventeen hours after the perforation. As no perforation could be found on the anterior surface of the stomach, the lesser omentum was carefully torn through and the posterior surface explored. A small, recent-looking ulcer was found near the lesser curvature, with a small perforation in its centre. With considerable difficulty six Lembert's sutures were inserted so as to invert the ulcer. Irrigation was not performed, but free drainage was employed, a Keith's tube being placed in the pelvis, and a tube and gauze strips passed down to the lesser curvature. The patient made a good recovery.

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* Whenever during an abdominal section it is necessary to keep viscera outside, it should be the duty of one assistant to see that their temperature is maintained and that their surroundings are aseptic only, and it should be the duty of a separate nurse to help in this.

Mr. J. R. Morrison, of Newcastle, adopted this plan (*Brit. Med. Journ.*, vol. ii.
, p. 864). The patient survived till the ninth day, and at the necropsy the peri-
tis was limited to the pelvis.

iii. **Cleansing of the Peritonæal Sac.**—Though most stress has been laid upon the point of efficient suturing of the perforation, there is no doubt that this one is quite as important. The fluid used should be boiled water or saline infusion, *e.g.*, sod. chlor. ʒj.—Oj. of boiled water at a temperature of 105° to 110°. If no irrigator is at hand a glass tube or the end of an œsophagus-tube, attached to india-rubber tubing (all having been sterilised) and arranged as a syphon or attached to a funnel, will answer very well. Failing this, a clean Higginson's syringe will suffice, if some one else pumps in the fluid so as to set free both the surgeon's hands for the delivery and distribution of the fluid. The cleansing must be systematic, persevering, and thorough. The whole cavity must be gone over in a regular way, and there is no better method than that given by Dr. Maclaren, who has operated in three cases, in one with success (*Brit. Med. Journ.*, vol. ii. 1894):

> "The plan I take is to begin with the neighbourhood of the rupture, wash it well; then starting from this as a centre, to make the nozzle follow the course of the colon, first towards the cæcum, specially cleaning out below the liver; secondly, starting again from the stomach, to follow the great bowel to the rectum. In this latter course the lumbar and pelvic hollows should receive special care. Finally, the douche is directed among the folds of the mesenteric attachments of the small intestines. I have repeatedly noticed here, when all seemed clear, that a fresh turn of the instrument would empty some unsuspected pocket."

If the extravasation is limited, as it may be in very early cases, it is wiser not to irrigate, as this may do more harm than good. The soiled portion of the peritonæum should be carefully cleansed with soft mops of sterilised gauze, care being taken, on the one hand, to cleanse the parts as thoroughly as possible, and, on the other hand, to avoid damage to the peritonæum by using undue force.

Some surgeons prefer to trust entirely to mopping in this way without using irrigation at all; for instance, Mr. Barker (*Clin. Soc. Trans.*, 1900), who gives a list of twelve cases treated by mopping alone, with five recoveries. It would seem, however, wiser on the whole to irrigate thoroughly when the general peritonæal cavity is contaminated, supplementing this, if necessary, with careful wiping to get rid of any coarser particles that may be visible, and to trust entirely to wiping only when the extravasation is localised.

Before closing the abdominal wound **the question of drainage** will arise. The necessity for this largely depends upon the particular conditions found at the operation. If the case has been operated upon quite early, if the amount of extravasation is small and limited, and the area thoroughly cleansed, the abdominal wound may be closed without drainage. In the great majority of cases, however, drainage will be necessary. Usually gauze drains passing in various directions from the abdominal incision will meet all requirements: one should pass down to the seat of perforation; another upwards between the stomach, liver, and gall-bladder; and another downwards beneath the abdominal wall towards the umbilicus. Others may be added if thought advisable. If extensive extravasation implicating practically the whole abdominal cavity has taken place, a tube should be passed down into the pelvis through a small incision above the pubes, in addition to the gauze drains.

Rectal feeding must be employed for at least forty-eight hours, nothing being given by the mouth during this time save sips of tepid water. It will be well to watch these cases for a long time after. Thus, Mr. Silcock reports a case treated successfully by drainage, the ulcer not being found: the patient "has suffered since from impaired locomotion of the stomach, and has been from time to time under treatment as an out- or in-patient."

Causes of Failure.—In every new operation especially it is well to bear these in mind. The chief are: (1) Peritonitis existing before, and not removed by, the operation. This has been the most frequent cause of death. It was so in two cases on which I operated. Both were under the care of Dr. Newton Pitt:

In the first the symptoms of shock and peritonitis were distinctly subacute and slightly marked. My colleague, however, was sure of his diagnosis, and when the abdomen was opened an open ulcer was easily seen on the anterior surface, from which a greyish liquid was continuously gushing. On bringing the perforation outside the abdomen, the opening was felt to be surrounded by a large callous base. Death took place from peritonitis forty-eight hours later; at the necropsy the ulcer was found firmly sutured. In the second case operation was refused at first when urged upon the patient, and it was not until the third day, when the abdomen was greatly distended, tympanitic, and motionless, that the patient and her friends, seeing how hopeless the case was getting, gave their consent. When the abdomen was opened the stomach itself was greatly distended. The peritonæal sac, especially at its upper part under the liver, between this and colon, spleen, and kidneys, was filled with purulent fluid, in which the more solid part of the last meal taken (Scotch broth) could be seen floating. All the viscera seen were thickly scattered with thick yellowish flaky lymph. This was especially present, together with numerous soft adhesions, between the lesser curvature and the liver. Had I broken down and searched amongst these I should have found the ulcer,* but the anterior surface being sound, and the stomach greatly distended, I examined the duodenum and found, as I thought, a minute perforation, a softened spot on the anterior and inner part of the first portion, into which a probe passed. This I sutured, and sponged and washed out the peritonæal sac. The patient was in a most critical state at the time of the operation, and sank thirty-eight hours after. At the necropsy a perforation was found on the lesser curvature.

(2) Shock of the operation and anæsthetic. (3) Abscess between the stomach and liver causing septicæmia or leading to empyema:

The treatment must be efficient drainage; an incision being made in front, in the middle line or over any epigastric prominence. Drainage should also be afforded behind by resection of one or more ribs (*Lancet*, vol. i. 1893, p. 145), or a glass drainage-tube be employed as in a case of Dr. Ewart and Mr. Bennett's (*Lancet*, vol. ii. 1894, p. 1147). *Vide* also chronic perforation, p. 209.

(4) A second perforation. This is stated by Finney (*loc. supra cit.*) to be present in 20 per cent. of the cases, and a careful search should therefore always be made for a second ulcer. Again, a second perforation may take place after the operation, for when the ulcer is very large another spot may give way, probably from softening set up by the local inflammation due to suturing.

Mr. Gould (*Brit. Med. Journ.*, vol. ii. 1894, p. 861) mentions a case of Mr. Pepper's in which a perforation had been sutured. For three days the patient did well, when she suddenly became collapsed and quickly died. The necropsy showed that the perforation which had been sutured was in the front part of an ulcer the size of a crown-piece, the line of suture being perfect and water-tight, but that a second perforation had occurred at its posterior part.

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* No surgeon should leave these unexplored in the hope of a natural cure. This, if accomplished, will very likely be so at the cost of a sub-phrenic abscess and septicæmia. See also the remarks above.

B. **Chronic Perforation.**—Instead of sudden perforation, with escape of the contents of the stomach into the general peritonæal cavity, the perforation here is associated with the formation of adhesions and the production of a localised abscess. This may be brought about in several ways. In some cases the base of the ulcer becomes adherent to a viscus —liver, spleen, or pancreas,—subsequent perforation giving rise to an abscess which slowly burrows first into and then beyond the viscus involved. In other cases, the perforation is preceded by a plastic peritonitis resulting in the formation of adhesions, which thus limit the diffusion of gastric contents when perforation occurs. Again, the leakage of gastric contents may at first only take place quite slowly, owing either to the small size of the perforation, to the stomach being empty at

Fig. 47.

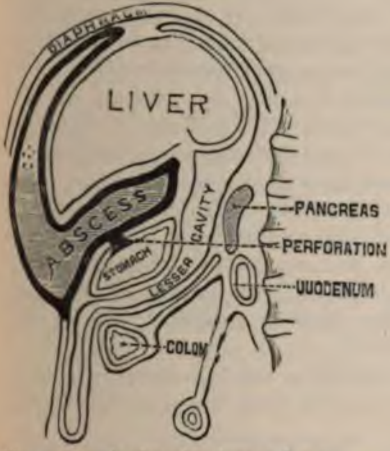

Diagram of sub-phrenic abscess from perforation of the anterior wall of the stomach. (Greig Smith.)

Fig. 48.

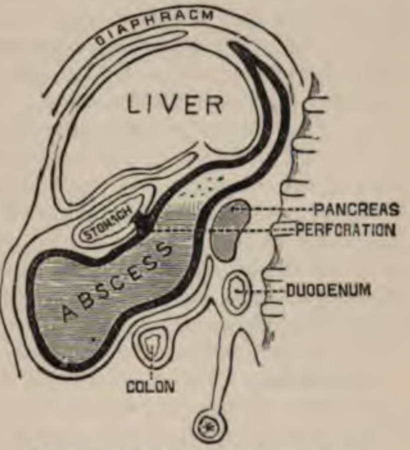

Diagram of sub-phrenic abscess from perforation of the posterior wall of the stomach. (Greig Smith.)

Fig. 49.

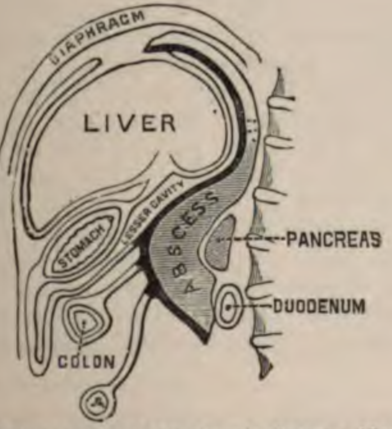

Diagram of retro-peritonæal sub-phrenic abscess. (Greig Smith.)

the time, or to the perforation taking place during the night. The abscess so produced is in most instances of the *subphrenic* variety, the majority of which are caused by gastric ulcers.

The limits of the abscess vary according to the site of the perforation, as will be understood by reference to the accompanying illustrations. Fig. 47 shows the boundaries of an abscess produced by perforation of an ulcer in the anterior wall of the stomach. It will be seen to be limited below by adhesions between the great omentum and the anterior abdominal wall, and above by the diaphragm and anterior layer of the coronary ligament of the liver. Usually the abscess involves one side only, being bounded internally by the falciform ligament of the liver. In Fig. 48 is shown an abscess produced by a perforation in the posterior wall of the stomach. Here the abscess cavity involves the lesser sac of the peritonæum, the foramen of Winslow being occluded by adhesions. The third variety, shown in Fig. 49, will be seen to be in reality a retroperitonæal abscess. Such an abscess will be caused by a perforation in the posterior wall of the stomach, where the two walls of the lesser sac of the peritonæum have previously become adherent, or, in some cases, by perforation of a duodenal ulcer.

Operation.—The treatment of the condition resolves itself into drainage of the abscess, any attempt at closing the perforation in the stomach being generally out of the question.

If a diagnosis of sub-phrenic abscess has been made, and the limits of the abscess can be ascertained, it may be opened through the lower part of the chest wall, portions of one or more ribs being resected. Care must, however, be taken to prevent infection of the pleural cavity, by suturing the two layers of the pleura to one another, if these are not found to be already adherent. The abscess may then be reached by pushing a director through the diaphragm and enlarging the opening with dressing-forceps. In the majority of cases, however, the condition will be first discovered on exploring the abdomen by means of a median incision. If the abscess is of the first variety, it will be opened at once on dividing the peritonæum, and may be drained entirely through the anterior incision, or a counter-puncture may be made in the side. Should the abscess involve the lesser sac of the peritonæum, it may be opened through the gastro-hepatic omentum after the general peritonæal cavity has been shut off by careful packing with iodoform gauze.

Infection of the general peritonæal cavity can be avoided either by drawing off the pus with an aspirator, or by making only a small opening and then carefully mopping up the pus as fast as it escapes. After the cavity has been completely emptied and wiped as clean as possible, it must be explored by the finger, and a counter-opening for drainage made in the side. The soiled gauze surrounding the anterior opening is now replaced by clean iodoform gauze, and the wound partly closed.

PERFORATING DUODENAL ULCER.*

Very little need be added here to the account just given. This form of ulcer occurs most frequently in men, and perforation may cause symptoms indistinguishable from those of acute intestinal obstruction (Lockwood). The only hope is that the case may be seen early, and evidence obtained that the pain felt was at first epigastric, and any early tenderness referred to the right epigastrium.

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* My readers will find cases recorded by Mr. Lockwood, *Lancet*, vol. ii. 1894, p. 969; Mr. Eve, *ibid.*, p. 1092; and Mr. Shield, *ibid.*, vol. i. 1895, p. 1169.

Operation.—Where no such information is at hand, the surgeon will make a free median incision with its centre at the umbilicus; the appendix, Fallopian tubes, &c., will be found healthy; perhaps an escape of gas will take place when the peritonæal sac is opened, and it may be noticed that the fluid which is the cause of the peritonitis is not fæcal in character.* If the operation be early the fluid may give an acid reaction, if time have not elapsed for this to be neutralised by the secondary peritonæal effusion.

The ulcer is most commonly met with on the anterior aspect of the first piece, and is thus accessible. Sometimes it is on the posterior surface, as in one of Mr. Lockwood's cases in which the necropsy showed that it would not have been seen at an abdominal exploration.† In the further details and essentials of the operation the account already fully given for the treatment of the much more frequently perforating gastric ulcer must be closely followed.

PERFORATION OF TYPHOID ULCER.

The results of operation for this condition have during recent years undergone a steady improvement. In a list of eighty-three cases which Keen (*Surgical Complications and Sequelæ of Typhoid Fever*) gives, there were sixteen recoveries; 19·2 per cent. of the operations, therefore, were successful.

This improvement is doubtless largely due to earlier diagnosis of the condition, and therefore earlier operation; and as the feasibility of the operation becomes more fully recognised by physicians and surgeons alike, a still greater proportion of successes will no doubt be obtained. Keen may be quoted on this point; he says—"When once the physicians are not only on the alert to observe the symptoms of perforation, but when the knowledge that perforation of the bowel can be remedied by surgical means has permeated the profession, so that the instant that perforation takes place the surgeon will be called upon, and, if the case be suitable, will operate, we shall find unquestionably a much larger percentage of cures than have thus far been reported." But, although earlier diagnosis will do much to render these cases more hopeful, it must not be forgotten that many of them will still be practically hopeless from the first, both on account of the serious condition of the patient and of the technical difficulties which the surgeon will have to face. Some of the cases mentioned later—for instance, those of Thomas and Allingham—serve to emphasise the latter point.

The cases may be divided into two different classes—the first, in which perforation takes place during the height of a severe attack; the second, in which the perforation occurs during convalescence or a mild relapse. In the former class the prospect is almost hopeless from the first; in the latter, however, there is a considerable chance of success.

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* That this is not always so is shown by Mr. Eve's case. The fluid is described as "sero-purulent with a fæcal odour" and as "purulent fæcal fluid."

† So, too, in a specimen brought by Dr. Pye-Smith before the Pathological Society (*Lancet*, vol. ii. 1893, p. 1443), it is distinctly stated that the ulcer could not have been reached by operation.

Two anatomical points should be remembered in connection with operation. The first is, that the perforation nearly always occurs in the last few feet of the ileum; according to Keen it is in the ileum in 81·4 per cent. of the cases. The other point is, that more than one perforation may be present. In Keen's list there were two or more perforations in 16·7 per cent.

Operation.—This must be carried out on the same lines as those described for perforation of a gastric ulcer. Every precaution having been taken against shock, an incision is made in the middle line,* beginning a little above the pubes and continued upwards sufficiently high above the umbilicus. When the peritonæum is opened the cæcum must be taken as a guide to the lower end of the ileum.† Enlarged mesenteric glands or zones of intense inflammation may also be guides to the perforation. As soon as this is found the coil should be safely brought outside the abdomen, packed around with hot sterilised towels or gauze tampons, and the perforation closed according to the general and local conditions which the surgeon has to face. Thus, (1) if the perforation is single, small, and the surrounding intestine in a condition to hold sutures, the perforation should be closed with sterilised silk, a continuous suture first, and then Lembert's sutures if there be time. (2) If it is clear that the tissues are too friable to hold sutures, either the perforation must be excised—a plan adopted by Mr. Sutton—or (3) the perforation must be brought a little outside the abdominal wound and fixed by sutures which take up healthy bowel. Later on this artificial anus can be closed. (4) Where the mischief is very extensive, part of the intestine may be removed, and the ends united by a Murphy's button, or both brought outside and Paul's tubes placed in them (*vide infra*).

In a case recorded by Dr. Thomson, of Texas (*Med. Chron.*, Sept. 1895), the cæcum was so disorganised as to require removal. The two ends were brought outside. Death took place eight hours later. Another case, showing how terribly altered the tissues with which we have to deal may be, is mentioned by Mr. H. Allingham (*Lancet*, vol. i. 1894, p. 675). Here the ileum was adherent to the sigmoid flexure and tore to pieces when touched. Suturing of the perforation being impossible, it was fixed in the wound. Death occurred twenty-four hours later. Lücke, of Strasburg (*Deut. Zeit. f. Chir.*, Bd. xxv. Hft. 1, 2, Dec. 1886), excised a wedge-shaped piece of the intestine. The operation took nearly two hours, and the patient never rallied, dying nineteen hours later.

Owing to the condition of the patient any such steps as suturing and resection will be quite out of the question in most cases. Perhaps the plan that will give most successes will be to keep the perforation outside while the peritonæal sac is being thoroughly irrigated, and, a day or two later, to deal with it by suture, or resection. Lücke, whose fatal case of resection I have referred to, advises that this step should be performed in two stages.

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* Or one in the right linea semilunaris may be chosen. That in the middle line perhaps gives best opportunities for systematic irrigation.

† In an instructive case, nearly successful, as the patient lived until the sixth day after the operation, under the care of Dr. Cayley and Mr. Bland Sutton (*Clin. Soc. Trans.*, vol. xxvii. p. 137), the loop with the perforation in it was found in the pelvis.

ABDOMINAL SECTION IN PERITONITIS.

A. In Septic Peritonitis.

In dealing operatively with a case of peritonitis the surgeon may find the following **classifications** useful:

(A.) ***Cause.****—i. *Peritonitis set up by mischief in the intestinal tract, whether accompanied by perforation or not.* Instances of this group would be hernia, appendicitis, intestinal obstruction, malignant disease, a caseating mesenteric gland, gastric ulcer, duodenal ulcer, typhoid perforation. ii. *Peritonitis set up by mischief in other viscera than the intestine, whether accompanied by a perforation or not, e.g.*, a suppurating ovarian cyst, twisted ovarian pedicle, salpingitis, septic metritis, puerperal peritonitis,† ruptured bladder, suppurating gall-bladder or spleen. iii. *Traumatic peritonitis from the effects of contusion, gunshot or other injuries* (p. 281). iv. *Tubercular peritonitis.* This last will be taken by itself. (B.) ***Extent and Progress.***—In the first three classes, which are always septic, the two distinct varieties of Mickulicz (*Centr. f. Chir.*, No. 29, 1889), which, though they run into each other, form two types, should always be distinguished in practice, viz., (1) *the diffuse septic peritonitis*, in which a large portion of the peritonæal surface is quickly infected, and, no adhesions being formed, the infection spreads rapidly; (2) *progressive peritonitis*, where the peritonæum is only affected at first in the neighbourhood of the cause. This focus is at first shut off by adhesions, but as the process gradually spreads, larger or smaller quantities of purulent exudation are encapsuled between the glued viscera. Mickulicz thinks that the treatment in the two must be different. In the first the whole peritonæum must be disinfected as far as possible. In the second, not the peritonæum in its whole extent, but each interperitonæal focus must be opened separately.

Operation.—We will take here a case where the septic peritonitis is diffused, where the surgeon is in doubt as to its cause, and where he is met by that combination of ominous conditions which confront us in these cases, viz., peritonitis and effusion, a septic condition, distended paralysed intestines, and exhaustion from pain, vomiting, &c.

In no case is the need of meeting shock more imperatively needed, viz., bandaging the limbs in cotton-wool, a hot-water mattress, or hot bottles to feet and trunk. A hot brandy or port wine enema should be given immediately before the operation, and saline fluid should be injected into the cellular tissue of the axillæ or into a vein, either during the operation or immediately before it is commenced. In the worst cases no general anæsthetic should be given, but the local anæsthesia of cocaine or eucaine made use of. If, however, it is deemed advisable to induce general anæsthesia, ether or the A.C.E. mixture should be used, and only enough given to keep the patient quiet. There should be a plentiful supply of hot water which has been boiled, and care must be taken that no instruments or towels come in contact with the patient's vitals, either cold,* or just out of irritating chemical solutions.

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* It is plain, I think, from such carefully reported cases as one by Dr. S. West (*Clin. Soc. Trans.*, vol. xix. p. 36), that cases of idiopathic purulent peritonitis do, very occasionally, occur. Dr. Hilton Fagge (*Guy's Hosp. Rep.*, 1875) stated that in an experience of twenty years he had only met with two cases of acute peritonitis in which no local cause could be found. The pneumococcus as a possible cause must also be remembered.

† I fear the pathology and the published cases in which abdominal section have been resorted to here are alike most unfavourable. If the surgeon interfere early, he will probably only find a congested condition of the peritonæum. If he wait till tympanites and purulent effusion be present, his efforts at relief will, I fear, be equally futile in the face of this severe general septic infection.

The skin having been well cleansed, the abdomen is opened by a sufficiently free incision in the middle line. Now, and throughout the operation, every manipulation is to be carried out as quickly as possible. Slow operation means failure (Lockwood).†

When the peritonæum is opened the next steps will depend upon the history of the case, and the fluid or gas which escape. If either of the latter be fæcal, the ileo-cæcal region is first examined, owing to the frequency with which the chief causes of inflammatory or mechanical obstruction are found here. If none are found, and the cæcum is distended, it is clear that the obstruction is in the large intestine, or is inflammatory. To settle this point the sigmoid flexure is next examined. If it be distended, and if there be no obstruction in the rectum—a point previously ascertained—the case is clearly not one of mechanical obstruction (Lockwood). The odourless gas and acid fluid mixed with recently taken food which escapes from a gastric perforation, the brownish acid fluid (occasionally fæcal) which may come from a similar lesion in the duodenum, have been alluded to above. Gelatinous-looking fluid probably indicates a ruptured cyst. Bloody ascitic fluid ordinarily points to hæmorrhage or a malignant growth.

In other cases, the history, the age, or the presence of enlarged mesenteric glands may point to the rupture of an abscess due to a caseating gland, or a rounded body in the pelvis to a suppurating ovary.

We will next suppose a perforation closed, or some other cause removed, and now we have before us how best to deal with the conditions remaining, viz., the distended paralysed intestines, the removal of the septic fluid, and the question of drainage.

I have already, under the treatment of acute intestinal obstruction, dwelt upon the necessity of emptying the intestines before the abdomen is closed;‡ otherwise death is almost certain, from the continued toxæmia from the persisting passage of organisms, of which the bacillus coli communis is only one, and from the interference with the action of the lungs and heart by the pushed-up diaphragm.

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* A temperature of 105° will be sufficient for instruments, towels, &c., and, as I have said before, if any viscus has to be withdrawn outside the abdomen it should be the duty of one assistant to keep its temperature from falling, and of one more to keep him supplied with towels or tampons previously carbolised and wrung out of sufficiently hot water.

† *Med.-Chir. Trans.*, vol. xxviii. Here will be found one of those rare cases of diffuse septic peritonitis saved by surgery. The cause was an unexplained perforation of the ileum.

‡ Travers, as Sir F. Treves (*loc. supra cit.*) calls him, "the father of intestinal surgery," long ago insisted upon the need of this, and urged that if the intestines were distended the operation was incomplete without this step. More recently Mr. Greig Smith and Mr. Lockwood have drawn attention to the need of this.

The emptying of the intestines may be effected by multiple punctures, (this being only safe if gas alone is present), with a fine trocar, such as a Southey's, the puncture being made obliquely. If the coats are softened and the puncture is not effaced by some of them gliding over the others, a drop of intestinal contents will very likely ooze out and continue to leak. This spot should be at once closed by a suture, with a very fine round needle, otherwise matters will only be made worse. Where fluids are also present, incising one or two of the most distended coils is preferable to the use of a large trocar, which, however sharp, is liable to leave lacerated edges. The incisions should be about three-quarters of an inch long and made in the long axis of the bowel, on the aspect opposite to the mesentery. As I have before said, even after boldly incising, the amount of relief secured is often disappointing. This is due in part, as the late Mr. Greig Smith pointed out, to the acute flexures in which the distended intestines are held by the mesentery, in part, also, to the easily paralysed condition of the bowel. The opening being brought well outside, and safely kept there by an assistant, the surgeon, partly by tracing up and squeezing adjacent coils, partly by elevating one end and lowering the other of each distended loop, aids the evacuation. As each coil is emptied it is cleansed and returned, but any incised loop is kept outside till the last, then closed with Lembert's sutures and dropped back.

Where any perforation is present it may be simply enlarged for drainage—a plan adopted by Mr. Lockwood in his successful cases. Where a patch is gangrenous and there is no time for resection, a Paul's tube may be inserted—a plan adopted in a case of acute intestinal obstruction due to bands, with great distension of the small intestines, under the care of Dr. Perry at Guy's Hospital, in 1895. The lad recovered with a fæcal fistula, which was subsequently closed (p. 278).

The next step is the cleansing of the peritonæal sac. The surgeon must here remember the distinction (p. 213), made by Mickulicz, between a *septic peritonitis, already diffuse and general, or one shut off here and there by adhesions, and so spreading more slowly. In the cases where the peritonitis tends to be of a plastic character*, where the intestines are matted here and there with lymph of varying tenacity, other parts of the peritonæal space appearing healthy, the surgeon has to face the following dilemma. If he separate the adhesions he will set up troublesome bleeding, he may break down important repair, and he may infect peritonæum still uncontaminated. On the other hand, by not disturbing the adhesions, he may leave pools of septic fluid, and he may miss, just when it is within his reach, the chance of closing some perforation, or of removing some other cause of all the trouble. I have mentioned such an instance at p. 208, in the treatment of perforated gastric ulcer.

Sir F. Treves's authoritative opinion in these cases inclines (*loc. supra cit.*; *Brit. Med. Journ.*, vol. i. 1894, p. 519) to "doing no more than is necessary, or as little as is obvious. A clump of adherent intestines will often cover and protect a perforation, and the ubiquitous lymph will many times close such an opening with more speed and security than are provided by any system of suturing.* . . . . The main purpose of the operation is to allow a noxious exudation to escape, and, if possible, to free the peritonæum of the cause of its trouble. . . . . If the operator can rid the serous cavity of the effects of the perforation, he may very often leave the breach itself to be dealt with by natural means."

Sir F. Treves goes on to say that irrigation is certainly not suited to this class of case—peritonitis partially localised by adhesion—gauze sponges forming here the best means of cleansing the peritonæum. Drainage is seldom required, and when employed is best provided for by strips of iodoform gauze passed among the coils to the necessary depth. The same authority recommends, in this form of perforation, a liberal dusting of the serous membrane with iodoform, save in the case of children.

My own opinion with regard to these cases of septic peritonitis partially localised by adhesion is, that the chief point is drainage, especially where the fluid is purulent and fœtid. Drainage must here be secured at all hazards, both by gauze drains and tubes from in front, and by incisions behind. Repeated operations may be required.

It is in cases of *diffuse septic peritonitis* that the question of the best means of cleansing the peritonæal sac will especially arise. There is still considerable difference of opinion on this point, some surgeons strongly recommending and always practising irrigation, whereas others condemn it and rely entirely on sponging; others, again, make use of neither (*vide infra*). Even laying individual opinion on one side, it is no easier to judge from results, since successful cases treated by either method are necessarily few and far between. Moreover, in studying recorded cases it becomes quite evident that the condition described by different surgeons under the heading of general septic peritonitis is not always really the same.

Again, it should be borne in mind that the result in any given case depends largely upon two important factors, namely, the virulence of the infection and the resisting power of the individual, neither of which can be in any way gauged by the appearances on abdominal section; so that, on the one hand, in a case of infection with a virulence of low type in a patient of high resisting power, either irrigation or sponging may, although incomplete, be sufficient to turn the balance in the patient's favour; on the other hand, a very virulent infection in a patient whose resisting power is small will be certainly fatal, and this result will not be affected in the least by either irrigation or sponging. Finally, it must be borne in mind that, whichever method is adopted, and however completely it is apparently carried out, anything like a bacteriologically complete cleansing of the infected surface is quite out of the question.

Where the fluid is non-infective, *e.g.*, blood, hydatid, bile, &c., where it is recent or not widespread, and where the operation-area can be safely circumscribed, cleansing of the peritonæal sac can be best and most safely accomplished by the use of gauze sponges, either used dry or wrung out of boiled water or salt solution.

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* Sir F. Treves refers to Kaiser's statistics (*Deutsch. Arch. f. klin. Med.*, 1876). Here thirty cases of operation for perforative peritonitis were collected with eleven recoveries. In five of these the exact site of the perforation was not ascertained.

Where, however, the fluid is septic and widely spread, irrigation with sterile salt solution introduced at a temperature of 110° F. is probably preferable. In Sir F. Treves's words this should be "introduced at low pressure, but in a wide stream. The irrigating tube is of soft rubber, and may have a diameter of three-quarters of an inch. The tube itself is introduced into the belly cavity. The flow through it can be regulated by a clip. Any form of rigid nozzle is to be most strongly condemned. The solution should flow gently into the abdomen. The peritonæal cavity is to be flooded, and not to be scoured out with a violent stream of water which hisses and rushes from a vulcanite nozzle like a miniature fire-hose. When the belly cavity is quite full of fluid, the surgeon's hand, which is already in position, is moved to and fro amongst the intestines with great gentleness. By a movement of the hand, and pressure here and there, the fluid overflows from the wound, and is replaced by the steady stream. As the water which escapes becomes clear, the upper end of the table is raised so that the shoulders are much elevated, and then little has to be done but to wash out the most dependent parts, including especially the pelvis.[*] Finally, what fluid remains in the pelvis is removed with sponges, and a sponge on a holder is retained in the bottom of the pelvis during the introduction of the stitches, and only withdrawn at the last moment."[†] It is important that the temperature be constant, the abdomen not over-distended, and that the stream be not directed against the diaphragm. If these precautions be neglected alarming dyspnœa may take place (Reichel). Polaillon has noticed three cases of cessation of respiration in the human subject during irrigation (Treves). The most suitable fluids are the saline infusion already advised, or boiled water, or dilute solutions of boric or salicylic acid, or of iodine about ʒj.—Oiij. In order to render the flushing more efficient some surgeons allow the intestines to escape into hot moist towels. Mr. M'Cosh (*Ann. of Surg.*, vol. i. 1897, p. 686), with an experience of forty-three cases, makes a practice of this, except where the distension is enormous and the heart's action very weak. He says: "Where possible, however, even at a great risk, the intestines are removed, and if well protected by hot towels, I have not found that this evisceration increases to any extent the shock of the operation." Dr. Finney, again, who reports a brilliant group of five successive cases, all of which were cured (*Johns Hopkins Hosp. Bull.*, July 1897), considering the usual means adopted inadequate, goes even further than this, and, before returning the intestines, thoroughly cleanses each loop with gauze wrung out of hot salt solution, using "considerable force." It may be mentioned that Dr. Finney considers thorough wiping with sponges more useful than flushing.

Drainage.—Where the fluid was septic this should be employed. First as to *site*. As, at a necropsy, fluid is always found in the pelvis, and sometimes only there, a glass drainage-tube should always be placed in the pelvis,* so that fluid can be sucked out. Other glass tubes, or india-rubber ones of appropriate size and properly fenestrated, should be placed in those areas which have been most disturbed (Treves), or where especially septic collections were found, or where bleeding may be going on. These must be brought out in front, or, by counter-puncture, laterally or behind. Provisional sutures must always be inserted. The tubes may usually be removed in forty-eight hours. If the discharge that is sucked out of any of them be foul, it is best to trust to frequent withdrawing of the fluid. Irrigation by the tube may produce fatal collapse, and it is difficult to make certain of the return of the fluid sent in.

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[*] From first to last the whole peritonæal sac and its contents must be gone over as methodically as possible. For ensuring this the excellent directions of Dr. Maclaren, of Carlisle (p. 207), should be remembered.

[†] There are some who hold that irrigation fluid may safely be left behind, as the peritonæum has well-known powers of absorption. Such too often forget that here we are dealing with a damaged sac, not the healthy one of experimenters.

Gauze drains are made of strips of iodoform gauze about one inch and a half wide and containing five or six layers.† They are largely used by Continental surgeons.‡ The objection to this form of drainage is the risk of poisoning, the difficulty and pain in removing them, and the greatly increased risk of hernia. As it is certain, however, that the necropsies in septic peritonitis show, most constantly, inadequate drainage, I am of opinion that the above means of drainage should be much more extensively employed, until replaced by treatment more satisfactory. The great importance of drainage in these cases is emphasised by the fact that of ten cases of generalised septic peritonitis treated by Dr. Van Arsdale by drainage only, recovery took place in eight (*Ann. of Surg.*, vol. ii. 1897, p. 238). Neither flushing nor sponging was employed here, but simply the making of two incisions and introducing "large rubber drainage-tubes in different directions through the openings, and packing with iodoform gauze."

Where the peritonæal surface has been unavoidably damaged, as in the separation of adhesions, the treatment must vary according to the severity of the lesion. In slight cases iodoform may be rubbed in, in severer ones an omental graft employed, or tamponnading with iodoform gauze. The latter is the most generally applicable, and that with the least delay.

After-treatment.—Two points only will be referred to here. They are the most important. One, the need of persevering persistence in combating shock; the other, the value of aperients. If tympanites and distension supervene or continue, the paralysed, thinned intestinal walls probably allow of the passage through of bacteria or their products, which are taken up from the peritonæal sac, thus giving rise to a toxic state. The passage of the long tube, the introduction of enemata containing ol. ricini ℥ij., ol. terebinth. ℥ss., or mag. sulph. ʒij.; or, if the patient can swallow, the administration of calomel gr. ij. every two hours may be very useful. Dr. M'Cosh (*loc. supra cit.*) advocates injections of magnesium sulphate into the intestine at the close of the operation. He makes the injection into the small intestine as high up as possible, and uses a saturated solution containing between one and two ounces of magnesium sulphate, the needle puncture being closed with a Lembert's suture. Where the bowel has been emptied by incision the above may not be required. Finally, by the firm application of towel-pads the onset of tympanites may sometimes be prevented.

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* Sir F. Treves writes as follows on this point: "There seems little to commend the employment of a glass tube passed into the fundus of Douglas's pouch. I have ceased to use this appliance." This advice, I think, though it is not so stated, should refer only to cases where the peritonæal sac has been thoroughly dried, or where the degree of sepsis was but slight.

† Jalaguier (*Bull. de Mém. de la Soc. de Chir.*, 1891, p. 800) is quoted by Sir F. Treves as having passed these strands in all directions amongst the intestinal coils from the diaphragm to the pelvis with a good result.

‡ The Mickulicz drain or tampon is used to check dangerous abdominal hæmorrhage, to close extensive breaches in the peritonæum, or to shut off structures which are septic. It is a sheet of iodoform gauze placed *in situ* as an open bag, and stuffed with strips of the same material. These are removed piece by piece after the first forty-eight hours; a few days later, when empty, the bag itself is removed.

B. In **Tubercular Peritonitis.**

Although the question of the advantage of operation in this disease has been much debated, there can now be little doubt that, in suitable cases, great benefit has often resulted from operation. It is still very difficult to determine the actual percentage of permanent cures, owing to the small number of cases that have been efficiently followed up. Dr. H. P. Hawkins (*St. Thomas's Hosp. Rep.*, 1892), from an examination of 100 cases treated consecutively at St. Thomas's Hospital, came to the conclusion that there is but little difference in the mortality whether operation is resorted to or not. Such slight difference as does occur is in favour of operation. The following figures, quoted by Mr. Watson Cheyne (*Lancet*, vol. ii. 1899, p. 1725), are distinctly more favourable. In 1895, Roersch published 358 cases with the following results. The deaths immediately due to the operation numbered 32, deaths at a later period (within eighteen months) and due to extension of the disease, general tuberculosis, &c., numbered 51. In the rest of the cases improvement followed, and many were apparently cured. For instance, in 53 cases two years and upwards had elapsed since the operation, and the patients were apparently quite cured. According to these figures, improvement or cure therefore results in 75 per cent. of the cases operated on. As pointed out by Mr. Watson Cheyne, this percentage is too high, since many cases relapse even after prolonged periods of apparent cure, and, moreover, the successful cases are more likely to be published than the failures.

Mr. Watson Cheyne, as a result of his own valuable experience, considers that improvement takes place in about 50 per cent. of the cases, and he states, moreover, that in many the rapid improvement after operation was most remarkable. He says: "I must confess that I have been surprised at the recovery of some of these cases. On opening the abdomen one finds tubercles everywhere, the intestines protrude from the wound and are seen to be red, inflamed, and covered with tubercles, some of them sometimes of considerable size, the abdominal cavity feels like a bag of rice; and yet in these cases recovery may follow. In two cases in which I made a very bad prognosis after the operation, on account of the size and the number of the tubercles scattered all over the intestines and abdominal cavity, recovery took place rapidly, and apparently completely."

From the point of view of surgical interference in this disease, the following classification of the principal types of the affection is important.

A. *The Ascitic.*—Here the inflamed peritonæal sac and its contents are studded, as far as can be seen, with hosts of grey "sago grain" granulations, tending to become confluent. Caseation is absent, or only present in a very early stage. The fluid is rarely sero-purulent. Adhesions are absent or insignificant. The fluid here may be localised and encysted. The ascitic form may come on very insidiously, and is not uncommonly the subject of a mistake in diagnosis. B. *The Caseating and Purulent.*—Here caseation is always present; the amount of pus varies. Usually this is abundant, and is too often encysted, imperfectly, in many collections. More rarely the caseation is dry, unattended with effusion, the intestines being matted together by adhesions which are themselves infiltrated and caseating. If the adhesions are separated, hosts of small loculi present themselves, with scanty fluid, usually purulent. The caseating is the variety which we see so typically in wasted children with hectic, vomiting, and diarrhœa. C. *The Fibrous.*—This is the rarest, but a favourable variety. The bacilli are probably few. Caseation is absent, and any fluid present serous and scanty. In this form and the second, if such parts as the omentum and mesentery are densely infiltrated, a new growth may be closely simulated.

The amount of improvement after operation that may be expected in any case of tuberculous peritonitis depends chiefly upon two considerations—(1) the stage which the disease has reached, and (2) the type of disease that is present.

(1) *The Stage of the Disease.*—It is most important that the operation should be undertaken before the vitality of the patient has been much diminished by general failure of nutrition, hectic, or tuberculous disease of other parts, &c., in order that the effect of the operation itself may be quickly recovered from. For in the advanced stages of the disease the shock alone of the operation may be sufficient to bring about a fatal result, or in any case to hasten the end. Mr. Watson Cheyne's advice (*loc. supra cit.*) on this point may be quoted: "I should say that in practically all cases where improvement does not follow under medicinal treatment after a reasonable time, say in from four to six weeks in acute cases to from four to six months in chronic cases, the abdomen should be opened whether there be ascitic fluid or not. The operation may do good in cases where it is least expected to do so, and it is but seldom that it can do any real harm. Do not in any case allow the patient to go downhill too much, otherwise one cannot expect good results to follow, and it is fair neither to the patient nor to the surgeon."

(2) *The Type of Disease.*—The most favourable cases are those belonging to Class A, where there is free fluid and the adhesions are few. Class C is also favourable for operation, but Class B is distinctly unfavourable. Here the operation may do much harm, for adhesions are numerous and the wall of the bowel often much thinned. The result of manipulation is frequently the production of one or more fæcal fistulæ, with perhaps the setting up of acute suppuration. Improvement has, however, resulted even in some of these cases, for Mr. Watson Cheyne points out that there is no class of cases in which some improvement has not taken place, so that it is very difficult to absolutely exclude any case from operation.

Operation.—In the majority of cases this consists simply in opening the abdominal cavity by means of a median incision and letting out the fluid. The escape of the fluid may be facilitated by turning the patient on to his side, and also to some extent by sponging. Where the fluid is loculated by means of adhesions, the separate loculi may be made to communicate by gently breaking through such of the adhesions as may be necessary for this purpose. No extensive disturbance of the adhesions beyond this is either necessary or advisable. There is nothing to be gained by either washing out the abdominal cavity or by drainage, so that as soon as all the fluid has escaped the abdominal wound should be closed and the dressings applied. In carrying out this operation, in some cases an obvious primary seat, such as a tuberculous Fallopian tube or cæcum or appendix, may be discovered. This may be removed should the condition of the patient be such as to admit of the necessary prolongation of the operation, and if the adhesions are not so numerous as to render the procedure very difficult. In many cases, however, in which such a primary focus is found, it will be firmly fixed to other important structures or embedded in a mass of adhesions; in such cases the wiser course will generally lie in making no attempt at a radical operation, but in resting content with letting out the ascitic fluid as described above.

If on opening the abdomen the case is found to belong to Class B, great care and gentleness must be used in opening up and dealing with abscess cavities, for the walls of the intestines are frequently thinned and softened by the disease, so that any undue roughness in handling is extremely liable to result in rupture of the bowel, either at the time or later, causing fæcal abscess or fistula. No attempt should be made in such cases at eradicating the disease, but abscess cavities may be treated as tuberculous collections elsewhere are treated, by evacuating the contents, gently swabbing out the cavity with pledgets of sterilised gauze, introducing sterile iodoform emulsion, and then closing the cavity. If the pus is, however, found to be fæculent owing to infection from the bowel, the abscess must be either drained with a tube or stuffed lightly with tampons of iodoform gauze.

ENTEROSTOMY.—FORMATION OF AN ARTIFICIAL ANUS IN THE SMALL AND LARGE INTESTINE.

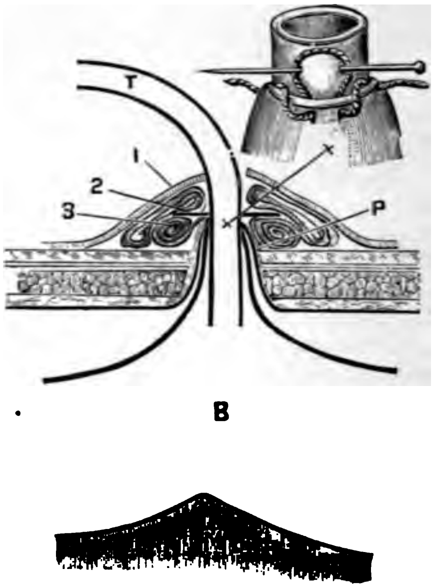
This subject has, in part, been already considered under Colotomy; I now allude to it again to aid my readers when they have to face the following indications:

A. **Chiefly referring to the Small Intestine and Acute Intestinal Obstruction.**—Either a temporary or a permanent opening may be made. **Temporary drainage** is called for (1) when the surgeon decides, owing to the patient's condition, not to perform an ordinary abdominal section, but to relieve the distension as a temporary measure by opening the bowel above the obstruction; (2) in those cases (already referred to, p. 178) in which distension of the small intestine is considerable, and in which the obstruction has been successfully relieved.

A **permanent opening** will be necessary when the surgeon cannot detect the site of obstruction, or where he finds it, but cannot remove it. Under these circumstances he may be driven to open the small intestine. The opening must be as near the cæcum as possible, in order to avoid the danger of death from inanition which would be caused by an opening high up in the small intestine.

Such operations are only palliative, and are only to be made use of when the adoption of other and more desirable courses is impossible, or when the surgeon feels sure he can open the small intestine low down. It has been urged by those who have recommended such operations—*e.g.*, Nélaton, 1840—that some obstructions relieve themselves if a temporary outlet has emptied the accumulation above. This may be true of a very small number of cases—*e.g.*, volvuli which have not gone too far, and loops which are incarcerated rather than strangulated. Another point urged in favour of this operation is that it involves much less shock and disturbance of the abdominal contents. This last is true. But, from what I have seen, this operation usually fails, by leaving irrecoverable mischief behind in the very cases to which it is best suited—viz., acute obstruction where the lesion cannot be found, or where it cannot be dealt with, or is beyond recovery. Even if it succeed it is at the cost of great and lasting inconvenience. Owing to the liquid state of the contents, control is very slight, and the raw and eczematous condition of the tissues adjacent to the opening is productive of great discomfort.

FIG. 50.

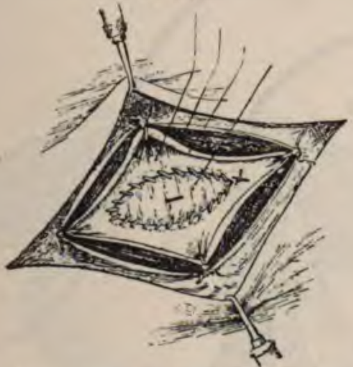


To show Greig Smith's method of performing temporary enterostomy.

B, Bowel. M, Mesentery. T, Rubber tube. P, Peritonæum. 1, Strapping, fixing dressing. 2, Pin holding bowel and tubing in position. x—x, Enlarged view of plan of fixing bowel and tube by pin and suture. (Greig Smith.)

Temporary Drainage of the Small Intestine (Figs. 50 and 51).—The following method, in which rubber tubing is used to carry off the contents of the bowel, was described by the late Mr. Greig Smith (*Abdom. Surg.*, p. 687), and will be found to be easy, rapid, and satisfactory. It is described as follows:—"Between the second and third fingers of the assistant's left hand and the same fingers of his right hand, held back to back, a V-shaped piece of the intestinal border is compressed and excluded. On the free border of this fold the incision is made large enough to admit the tubing. If the bowel is properly held no gas or fluid escapes. With fine peritonæal catch-forceps the mucous membrane on each side of the small incision is grasped and pulled out a little way, and the tubing, stretched over a blunt probe, is pushed through the opening. The tubing is at once fixed to the margin of the incision by a safety-pin or two, or in the manner shown in the diagram (*vide* Fig. 50). If it fits accurately there will be no escape of intestinal contents by its side. The fingers of the assistant are now removed, and the gases and fluids permitted to escape. When the bowel has collapsed the loop is cleansed and returned into the abdomen, leaving outside about an inch of bowel containing the tubing. The tubing should at its inner extremity clear the parietes, but need go no further inside. The parietal sutures already placed are now tied, all save one, which is to be tied in a few days when the extended loop is returned."

FIG. 51.

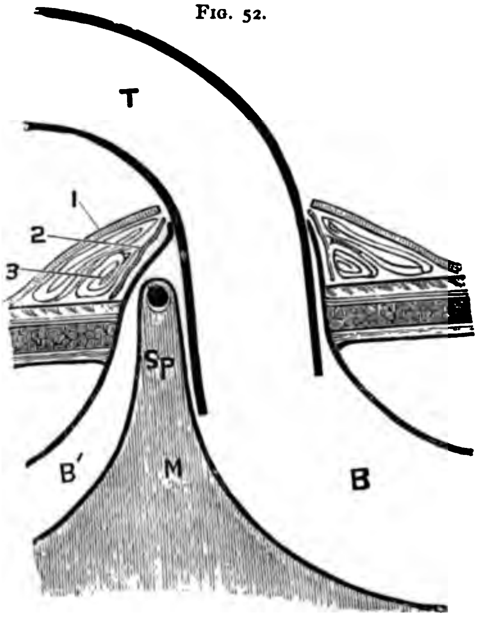


Fæcal fistula. The parietal and intestinal peritonæum have been united by a continuous suture (Kocher). This figure should be contrasted with Fig. 52, which shows an artificial anus. Here there is no prolapsus and no spur, this opening being intended for temporary purposes.

Instead of the above the following method may be used. The abdominal incision is closed with the exception of an inch and a half at the lower part. Here the parietal peritonæum is first united to the skin by a few points of suture. The loop of intestine which it is intended to drain is then carefully attached to the parietal peritonæum by a continuous silk suture, picking up the serous and muscular coats of the bowel on the one hand, and the parietal peritonæum on the other, as shown in Fig. 51. The sutured edges are then sealed with collodion. The bowel is now punctured by a trocar and cannula which have been passed through a piece of thin india-rubber sheeting, the contents of the bowel being allowed either to pass into the dressings or being led away to a suitable vessel by means of a tube attached to the cannula.

Formation of a Permanent Artificial Anus in the Middle Line (Fig. 52).—The contents of the peritonæal sac having been shut off by gauze tampons and sponges, the surgeon makes an artificial anus in one of the following ways:—A loop of intestine, as near the obstruction as possible, being chosen by its distension, congestion, &c., it is brought outside, and as much of the median incision as is feasible is safely closed with sutures. Those sutures which have to be placed nearest the intestine should not be tied, but kept clamped with Spencer Wells's forceps, so that the surgeon may easily draw out or replace some of the intestine as he requires. The intestine is now fixed either by some form of rod and sutures, or by sutures alone. In either case, if there be time, the parietal peritonæum may be sutured here and there, by points of fine silk passed with round needles, to the peritonæal coat of the intestine so as to shut off the general peritonæal sac, great care being taken not to perforate the lumen of the bowel. Then a piece of suitable bougie, glass rod, &c., which has been boiled, is passed through the mesentery, avoiding any vessels, so as to keep the loop well out of the abdomen. If too much bowel has been withdrawn some is now returned, the parietal wound closely sutured up to the projecting gut, and a few sutures placed between the intestine and the margin of the wound. These must not enter the lumen of the bowel. Finally, there must be no twisting of the gut as it is brought out. If the rod is used, care must be taken that too much of the gut is not prolapsed, a point rather difficult to secure by this method. The smaller the prolapsus consistent with safety—*i.e.*, non-contamination of the peritonæal sac—the less the irritation and bleeding from friction of the clothes, &c., in the future,

Fig. 52.



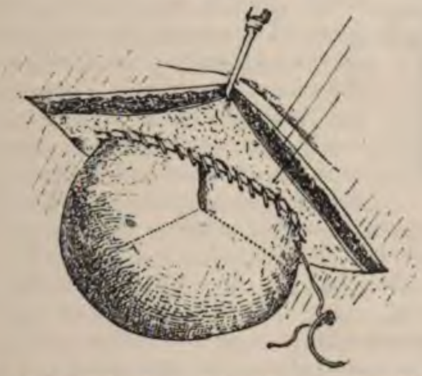
Formation of an artificial anus.

B, Bowel on proximal side of spur. B′, Bowel below spur. T, Rubber tubing. Sp, Spur: at the top the black circular spot represents a section of the supporting rod. 1, Strapping. 2, Gutta-percha tissue. 3, Absorbent dressing. (Greig Smith.)

and the smaller the opening to be closed by any subsequent operation if this prove feasible. If sutures alone are used, most of the above steps are the same, but extra care must be taken in closing the parietal wound, so as to support the intestine which is to form the artificial anus, and additional sutures must be passed between the edges of the wound in the parietes and the bowel. If this be distended much caution will be required lest the lumen is opened and the wound infected. The employment of the continuous suture is shown in Fig. 53.

Opening the Bowel.—If it be possible a few hours should be allowed to elapse.* But if immediate relief is required one of the following methods may be adopted. The whole of the wound, save where the opening is to be made, is covered with iodoform, and the sutured edges may be sealed with collodion and iodoform. (1) The bowel may be opened by a trocar and cannula which have been passed through a piece of thin india-rubber sheeting (Cripps) so that the fluid fæces do not flood the wound, &c. A very useful precaution is to insert a temporary suture into the intestine, close to where the opening is to be made, so that by pulling on this the surgeon can keep the bowel forwards and the flow away from the wound. (2) If the trocar and cannula are not forthcoming, the patient having been brought to the edge of the table and partly turned on to one side, the wound is protected with the above precautions, and the intestine opened by a small incision, the fæces as they escape being quickly washed away from the wound by a gentle stream of boiled water. (3) A piece of rubber drainage-tube may be inserted into the bowel, as described above in Greig Smith's operation for making a temporary fistula (*vide* Fig. 52). (4) A fourth method

FIG. 53.



Formation of an artificial anus. A continuous suture has been used (Kocher). It is evident that there will be a good spur and plenty of prolapsus; much of this will be cut away later on. This, which is intended for a permanent opening, should be contrasted with Fig. 51, which shows a fæcal fistula only.

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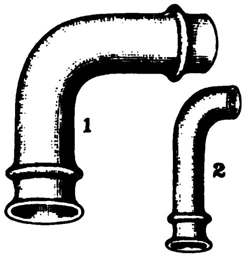
* If this delay is possible, a guiding-stitch should be inserted (not entering the lumen of the bowel) at the point where the opening will be made. This renders easy what otherwise, owing to the rapid alterations in the surface of the bowel and landmarks, may prove very difficult.

is to make use of a Paul's tube (Fig. 54). I have already referred to the use of the larger size in the performance of colotomy (p. 106).

The glass tubes are made in two sizes. That used for the colon or rectum (Fig. 54, 1) has been improved in shape by Messrs. Wright & Co., of New Bond Street, who have succeeded in bending it at the proper angle, which avoids all strain on the bowel. It measures 5 inches in length by 1 in diameter, has a double rim at the bowel end and a single rim at the distal end, and is bent at a right angle. The tube for the small intestine (Fig. 54, 2) is as light as is consistent with sufficient strength. It measures 2½ inches by ½ inch, and is bent at a right angle at the distal end. In either case, the end with the double rim is introduced into a small incision made in a loop of intestine, drawn out if possible, and safely shut off with aseptic gauze packing. The end thus inserted is then securely tied in with a silk ligature of sufficient stoutness. While this is being tied, an assistant with two pairs of dissecting-forceps should keep the edges of the opening in the bowel well pulled up over the rim of the tube. Fæces from the large tube are received into a jaconet bag containing wood-wool, or other absorbent material, except the first rush in cases of obstruction, which is best received into a basin. To the small one an india-rubber tube is attached, which conveys the liquid fæces of the small intestine into a bottle, beneath an antiseptic fluid (Paul, *Liverpool Med.-Chir. Journ.*, July 1892). Two **objections have been made to the use of these tubes.** One, that it is difficult to insert the tube without the risk of letting some fæces escape over the wound. This is certainly true when the intestine is distended and the fæces fluid. If, however, the loop to be opened is emptied into adjacent bowel, and temporarily clamped if possible, the introduction of the tube is greatly simplified; otherwise, the operator may safely trust to drawing out the bowel as much as possible and isolating it with gauze. The other objection is that the silk ligature may cut its way through too quickly, especially if the bowel is much congested. Thus, the tube may be loose in two or three days ; but it not infrequently remains for a week firmly adherent, partly because some of the circulation becomes re-established beyond the ligature, and partly owing to the copious exudation of lymph, which covers the bowel to the very end, quite concealing the ligature (Paul). The use of a purse-string suture to fix the tube in the bowel, and the prevention of undue tightness in tying in the tube, will help to lessen this trouble. If the tube becomes loose too soon, two or three Spencer Wells's forceps should be applied to the margins of the opening in the bowel, so as to keep this forward until the parts are more firmly healed.

FIG. 54.



I have given (p. 278) an instance in which, in 1895, after dividing two bands in a case of acute intestinal obstruction admitted on the fourth day, I drained the intestines by a Paul's tube tied into the worst of three gangrenous patches present. Vomiting with some tympanites continuing, I had an ounce of castor oil given by the tube. Abundant flatus was soon passed per rectum, and recovery steadily followed. Owing to the patient's brutish behaviour—he was discovered on the point of drinking his urine, he took solid food from other patients, and five days after the operation pulled the tube out of the bowel—a fæcal fistula followed, which I closed by the method given at p. 278.

Nelaton's Operation. Right Iliac or Inguinal Enterostomy.

Operation.—A horizontal incision, about two inches long, is made a little below the centre of a line drawn from the umbilicus to the right anterior iliac spine, or one lower down parallel with the outer part of Poupart's ligament. The cæcum having been made out to be empty, the relation of this to the distended coils which are present in the wound should, if feasible, be made out, so that the small intestine may be opened as low down as possible. In making the opening those details already fully given (p. 225) must be followed.

B. Conditions chiefly affecting the large Intestine and bringing about Chronic Intestinal Obstruction.—Enterostomy under these conditions has been already referred to in the account of colotomy.

Given a case in which the obstruction is somewhere in the large intestine, where, though perhaps the onset has been given as acute, the surgeon is clear, from the age, history, &c., that it is really a case of acute on chronic mischief, the following course should be followed.

An incision being made below the umbilicus, the surgeon examines first the sigmoid and then the large intestine up to the cæcum. The obstruction having been found, the surgeon must deal with it according to the patient's condition and his own surroundings. Many will prefer to close the median incision and perform a lumbar colotomy on the right or left side, according to the position of the obstruction. Others will bring, if possible, the cæcum or sigmoid or transverse colon into the median incision and establish the artificial anus there. I have stated at p. 91 my objections to thus drawing a piece of rather fixed large intestine up into the middle line. For my own part, having made out the obstruction, I should prefer to deal with it as follows, mentioning only the more usual sites (footnote, p. 92). If, as is most frequent, it is in the sigmoid, I should close the median incision, and bring out the sigmoid with the obstruction, and keep the loop outside with a rod and sutures (p. 104), and open it at once or a little later. This would give the opportunity of resecting the affected loop later on. Another course would be to close the median incision and perform a left lumbar colotomy. If the obstruction was in the splenic flexure I should try to bring the transverse colon out into the top of the median incision prolonged upwards, and open this intestine (p. 112). If the disease is in the hepatic flexure, a right lumbar colotomy would be indicated, the median wound being closed. If lower down, the cæcum must be opened. I have pointed out at p. 111 the chief objection to this step, viz., the liquid character of the escaping fæces.

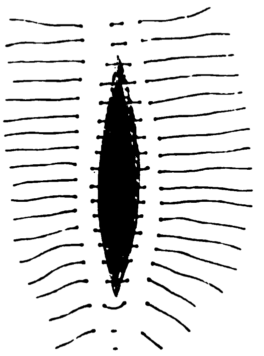
Operation.—Wherever the opening is made, the details already so fully given at pp. 94 and 103 will suffice.

UNION OF DIVIDED OR INJURED INTESTINE BY SUTURE OR OTHERWISE.

By Suture.—The methods devised are very numerous; most have quickly become obsolete. I shall only refer to four here, as those with which I am personally acquainted, and those which will be found, on the whole, the simplest and the most efficient. And first as to the **essentials of a good intestinal suture.** The chief are—

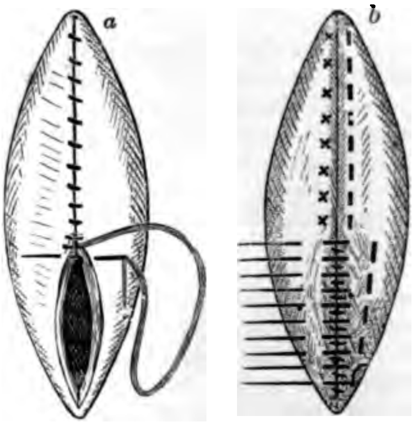
(1) It must be simple; one that can be rapidly introduced, and one which will effectually close the wound, and hold it secure until the parts are firmly healed. (2) In its introduction attention must be paid to the following: (*a*) The sutures, when applied from and knotted outside, must not pass through the mucous coat, otherwise they may draw septic fluids from within the bowel to the peritonæal surface. (*b*) Each suture should pass down to, and, if possible, take up a little of, the submucous coat, which is relatively strong and thick (Fig. 57). In any case, each suture must take a sufficiently firm hold, so as not to cut out when any strain is put upon it, *e.g.*, by peristalsis or distension. (*c*) Attention must be paid to the risk of sloughing along the edges if too many sutures be used, or if they be tied with strangling tightness. (*d*) The material used must be unirritating and sufficiently durable. Fine Chinese-twist silk, thoroughly sterilised by boiling and preservation in carbolic acid lotion (1 in 20), is the best material. The sutures are best introduced by the ordinary fine round sewing-needle, the aperture of which is at once plugged by the thread which follows, while its round shaft does not wound small vessels like the ordinary triangular-pointed needle, which is not needed here owing to the readiness with which the intestinal coats are penetrated. Fine curved needles must be used to introduce the sutures from within (Fig. 132). It will save much time to have many needles threaded and secured on lint in carbolic acid lotion. If possible, as many should be threaded as there will be sutures, both continuous and interrupted. These should be kept apart.

Fig. 55.



Lembert's suture, as used by Sir W. Mac Cormac in two successful cases of intraperitonæal rupture of the bladder.

Fig. 56.



To the left the continuous suture is shown. The right-hand figure shows the continuous one inverted and buried by a row of Halsted's sutures. (Jessett.)

Chief Varieties of Suture.—(i) **The Continuous Suture** (Fig. 56, *a*).—This has the advantage of being very quickly applied. If the points of entrance and exit be at some little distance from the margins of the wound, the serous surface will be distinctly inverted, and well apposed.

The objections to it are mainly three. (*a*) If one part of it becomes loose, the whole is liable to become insecure. (*b*) It is difficult in tightening it to secure even tension all along the line. (*c*) If the bowel contract, the whole suture may become loosened, and the wound gape. Thus this suture is not to be trusted to by itself, but when used in combination with Lembert's it is most valuable.

(ii) **Lembert's Suture** (Figs. 55 and 58).—The value of this depends on the fact that it fulfils in an eminent degree the condition first pointed out by the introducer, that to obtain union of an intestinal wound it is absolutely needful to bring and keep the serous surfaces in contact. Each suture should be inserted not less than one-third of an inch from the cut edge, and run along deeply in the muscular or in the sub-mucous coat; it is then made to emerge just wide of one cut edge, reinserted just beyond the opposite edge, then at once made to travel between the coats and to emerge as before.

FIG. 57.

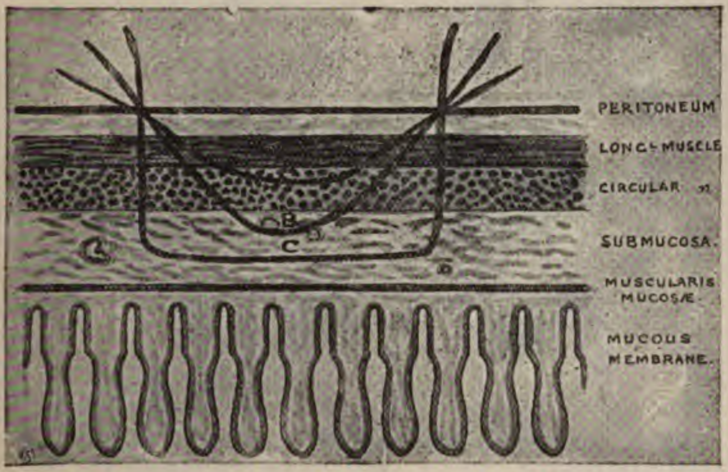


Diagram to show good and bad methods of inserting sutures.

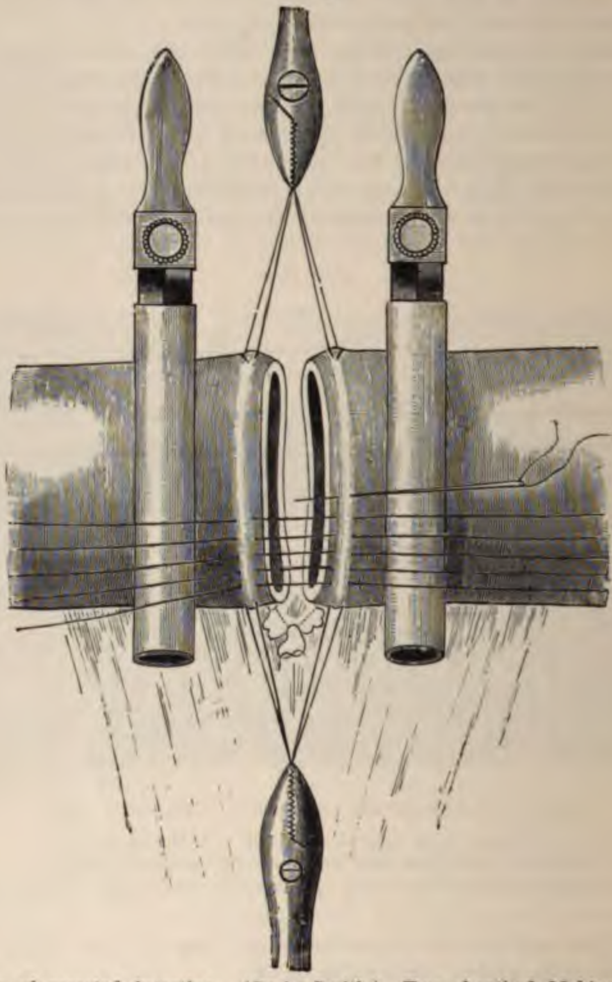
A. Bad method. Suture holds only muscle, and is liable to cut out.
B. Not good method; too little hold of submucosa, and too sloping.
C. Proper method; takes a good hold of the tough submucosa. (Greig Smith.)

(iii) **The Czerny-Lembert Suture.**—This is only Lembert's suture reinforced by a deep row in order to bring together accurately the margins of the mucous membrane, as well as to approximate more perfectly the serous surfaces. The introduction of the first or deep row is shown in Fig. 132. It will be seen there that these sutures are knotted within the lumen of the bowel, but it is better to make them in the opposite direction and tie them on the outside.

(iv) **Halsted's Quilt or Mattress Suture** (Fig. 56, *b*).—The distinguished surgeon who introduced this method claims for it that (1) it is so safe that a single row of it will suffice; (2) it constricts the tissues less than Lembert's sutures; (3) it tears out less readily if submitted to tension.

The plan adopted by most surgeons at the present day is to make use of a double line of suture—an inner continuous one, taking up all the coats of the bowel; and an outer row, consisting either of a second continuous suture, Lembert's sutures, or Halsted's sutures, but in all cases taking up only serous and muscular tissues, and thus bringing the serous surfaces into apposition. Which of these will be finally judged to be the most perfect method must at present remain uncertain.

FIG. 58.



Suture of resected intestine. (Greig Smith.) Two sheathed Makins' clamps are in position. The mesentery has been divided close to the intestine. Its cut edge is drawn together by a purse-string stitch: this leaves free small flaps of peritonæum, which can be grafted on to the base of the line of union.* Four sutures are inserted into the opposite sides of the resected gut, and careful traction made on them by an assistant. This raises a well-defined fold along the edge of the gut, which makes the insertion of sutures more easy and regular.

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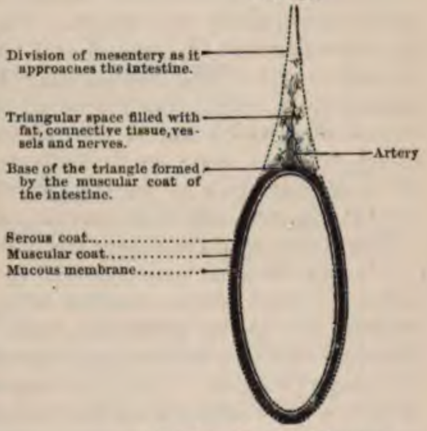
* Other methods of dealing with the mesentery are given at p. 264, Figs. 96, 97.

In performing the operation the following points require especial attention: (1) The sutures should be inserted about one-eighth of an inch from each other. (2) Adequate inversion of the edges and contact of the serous surfaces must be secured, this being effected by entering the sutures at a sufficient distance from the edges (in Fig. 58 this is not enough), and by an assistant aiding the inversion by dipping in the surfaces, just before each batch of sutures is tied, with a probe. (3) Much confusion and entanglement will be saved if the sutures are tied in batches of four or six, and cut short. (4) Each needle should carry only enough silk for one or at most two sutures, otherwise there is much coiling and catching about, perhaps on surfaces not aseptic, of a long thread. The mesentery having been tied off up to the level of the portions of bowel to be united, and the growth or gangrenous intestine having been cut away, the process of suturing is carried out as follows: Two fixation quilt sutures are first passed through the serous and muscular coats at the mesenteric border and at the opposite edge. These are held, as shown in the figure (58), in catch forceps, and, being kept taut by an assistant, serve to ensure the accurate apposition of corresponding points. The continuous suture is then introduced, taking up all the coats of the bowel close to the cut edge, in the following manner. It commences at the mesenteric border, and for the first half of the circumference of the bowel is passed from within, the mucous surface being punctured first by each stitch. When the fixation suture at the opposite border is reached, the order is reversed, so that the second half is passed from without, the serous surface being now punctured first. Finally, the two ends of the suture are tied together at the mesenteric border.

Fig. 59.


Division of mesentery as it approaches the intestine.
Triangular space filled with fat, connective tissue, vessels and nerves.
Base of the triangle formed by the muscular coat of the intestine.
Serous coat
Muscular coat
Mucous membrane
Artery

Section through jejunum. (Mac Cormac.)

The second row of sutures are now placed, taking up serous and muscular tissues only and inverting the first line of suture. Lastly, the fixation sutures are tied, and any points of apparent weakness or insufficient inversion reinforced by further sutures.

However circular enterorraphy be employed, close attention must be paid to these points shown in Fig. 59. The first is the triangular space which is formed by the divergence of the two layers of the mesentery at their junction with the bowel. This is occupied by fat, connective tissues, vessels, and nerves. In the suturing of resected intestine this space *must* be obliterated by sutures passing from intestine to mesentery (Figs. 97 and 99). The thickness of the bowel is also to be noted. The muscular layer is (Fig. 59) comparatively thick, and sutures here are easy of introduction. In the ileum this coat would be much thinner and the whole tube smaller.

The **advantages** and **disadvantages** of circular enterorraphy are given at p. 253, where this method of uniting intestine is compared with other means, such as Murphy's button, Paul's decalcified bone tubes, Mayo Robson's bone bobbins.

Rogers' Method of performing Enterectomy without the Aid of any Special Apparatus.—At the present time, while the best means of performing enterectomy are still *sub judice*, and as it will certainly have to be performed, under widely different conditions, in very different ways, the following deserves mention. It will be found described, *Brit. Med. Journ.*, 1896, vol. i. p. 903. The method consists in turning back the peritonæal coat of one end of the small intestine, suturing the muscular coat thus exposed to the peritonæal coat of the other end of the intestine, subsequently turning down the reflected portion of peritonæum over the first row of sutures, which are thus completely buried, and suturing the deep surface of the reflected peritonæum to the unreflected serous surface on the other end of the intestine. Thus a double sero-fibrous union is obtained which will unite both quickly and firmly. The inner sutures are passed through the muscular coat of one end and the muscular and peritonæal coats of the other end of the bowel, while the outer sutures include the peritonæal coats only. Each row of sutures is a continuous one. The second one, which unites the peritonæum reflected off one end of the bowel over the same coat unreflected on the other, begins by uniting the triangular gap at the mesenteric junction (a most important spot, p. 231, Fig. 59), and then travels round the bowel.

The following **advantages** are claimed by Dr. Rogers for this method: (1) It can be done with the aid of the instruments in a pocket-case, ordinary round sewing-needles being used (although curved intestinal needles are to be preferred), and with very little assistance, and is therefore likely to be of especial service in military surgery or in country or foreign practice. Yet (2) it can be completed in about half an hour, or only a little longer than the time required with the aid of such special appliances as plates, buttons, and bobbins. (3) The junction is a double sero-fibrous one, and hence, as the late Mr. Greig Smith believed (*loc. infra cit.*), will combine the maximum of rapidity and firmness. (4) The mesenteric junction can be made very firm by the apposition of the muscular coat of one end to the peritonæum of the other, and subsequent covering up of this suture by the reflected peritonæum.

The chief **disadvantage**, on the other hand, lies in the difficulty in reflecting the peritonæal coat. The late Mr. Greig Smith said: "This is not easy to do: it takes some time, and causes bleeding which is long in stopping. Also it often causes the wounding of important blood-vessels."

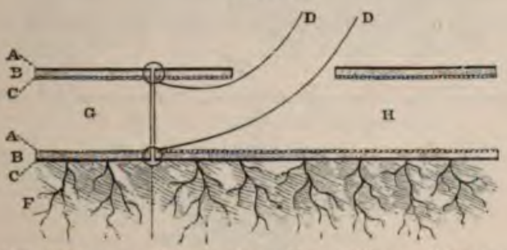
Another method somewhat similar to the above is Morisani's (*Centralb. für Chir.*, 1899, vol. xxxii.). This consists in removing a strip of mucous membrane from 4–6 cm. wide from the distal end of the divided bowel. The proximal end is then invaginated, its serous surface thus being brought into contact with the denuded area of the lower segment. The two ends are held by two or three fixation sutures and union completed by means of a continuous suture piercing the whole thickness of the distal segment and taking up the serous and muscular coats of the proximal segment. This method would appear to be quicker than, and quite as reliable as, Rogers' method.

MODIFICATIONS OF CIRCULAR ENTERORRAPHY. AIDS TO ITS PERFORMANCE, OR MEANS OF REPLACING IT.

Owing to the objections which some have raised against circular enterorraphy, other methods have been invented. I propose only to describe those which have stood the test of successful trials in the human subject, as well as giving good results in animals.

Method of Maunsell.*—This modification of circular enterorraphy is based on the fact that, when Nature performs enterorraphy successfully, she does so by the process of invagination, adhesive inflammation, and sloughing. The two ends of the bowel † are brought together by two long temporary sutures passed through all the coats of the intestine (D, D, Fig. 60), one being placed at the mesenteric junction, and the other exactly opposite. These sutures secure the peritonæal covering of the intestine, and serve, later, to effect invagination. A slit about an inch and a half long having been made in the long axis of the free border of the proximal part of the intestine, about an inch from the divided end of the gut, these two long sutures are passed up through the lumen of the bowel and out of the slit; when pulled upon, the smaller or distal end of the bowel will be invaginated into the larger, and drawn out of the opening in this (Fig. 61). From this figure, which shows the relative position of the layers invaginated, it will be seen that the peritonæal surfaces are in accurate apposition all round. While an assistant holds the ends of the temporary sutures up and apart, the surgeon passes a long, fine, straight needle, carrying stout

FIG. 60.



This and the next three figures show Maunsell's modification of circular enterorraphy A B C, Peritonæal, muscular, and mucous coats. F, Mesentery. D D, Temporary sutures by which the lower is invaginated into the upper end; they are seen to emerge through a slit in the latter. (From Walsham's *Surgery*; copied from Maunsell, *loc. supra cit.*)

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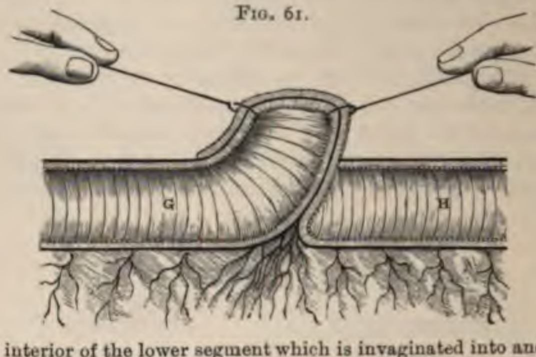
* H. Widenham Maunsell, late Lecturer on Surgery, Otago University (*Amer. Journ. Med. Sci.*, March, 1892). The inventor used his method first as long ago as 1886, after resection of the small intestine "for cancer" in a child aged 6. The child sank on the sixth day; at the necropsy the segment of the intestine showed no evidence of leakage. Dr. Wiggins (*New York Med. Journ.*, Dec. 1, 1894, and in his pamphlet, for which I am indebted to him) relates a successful case in which he resected six inches of ileum for contusion and perforation, uniting them by this method. The patient was well ten months later. Dr. Wiggins mentions a case of Dr. Harley's (*New York Med. Journ.*, vol. lvi. pp. 302 and 464), in which this method was also successfully employed for the resection of a double intussusception and carcinoma.

† The preliminary steps as to clamps, &c., would be the same as those given at p. 259.

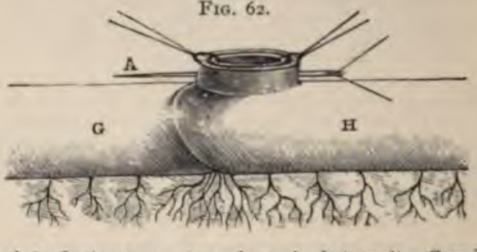
horsehair or very fine silkworm gut, through both sides of the bowel, taking a good grip (a quarter of an inch) of all the coats (Fig. 62). The suture is then hooked up from the centre of the invaginated gut, divided, and tied on both sides. *In this way, twenty sutures can be rapidly placed in position with ten passages of the needle.*[†] The temporary sutures are now cut off short, the sutured ends of the bowel painted with Wölfler's mixture of alcohol, glycerine, and colophonium, and dusted

FIG. 61.



G, The interior of the lower segment which is invaginated into and through the opening in the upper segment, H.[*]

FIG. 62.



A, The needle introducing two sutures by a single transit. G and H as before.

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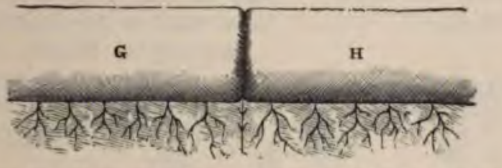
[*] Mr. Stanley Boyd in his case made the incision in the distal end, and invaginated, with a little difficulty, the upper larger into the lower small end.

[†] Mr. Stanley Boyd introduced here two or three modifications of this important stage, which may be useful. Finding that time was lost in drawing up the loops from the lumen of the bowel, and in selecting corresponding ends, he passed many of these sutures not across the lumen of the bowel but through only two walls, and tied the sutures as they were inserted. He found that great care was needed to ensure that the cut edges of the peritonæal coats were equally drawn up, and that each stitch passed a good quarter of an inch below them, for the mucous membrane tends to prolapse and to conceal the peritonæal edges which are of chief importance. Finally, finding the ends of the wet silk difficult to push up and disentangle, he used horsehair. This, if sterilised, and not brittle, is, as Mr. Boyd says, a safer material for a penetrating stitch. The late Dr. Maunsell strongly recommended it as superior to silk. The longest and strongest hairs, without a flaw, must be selected. Those from the mares' tails are unreliable, being often rotten with urine. When selected they should be well brushed in soap and water. They are then next placed to soak in a mercury bichloride solution for two or three hours, then shaken out and placed in a large glass-stoppered bottle. Before being used, the hair should be soaked for three hours in a similar solution to make it pliable (*loc. supra cit.*).

with iodoform. The invaginated gut is then pulled back.* Finally, the longitudinal slit in the gut is well turned in, and closed by a Lembert's continuous suture, and painted and dusted as above. The appearance of the gut is now as in Fig. 63; the serous surfaces should be in accurate apposition, and all the knots inside the bowel. Dr. F. H. Wiggins (*loc. supra cit.*), comparing this method and Murphy's button, pointed out the following as requiring careful attention when this method is employed: 1. The mesenteric border must be carefully approximated. 2. The sutures must be interrupted, and not placed too near the edge of the intestine; they should be placed a quarter of an inch from it, at least. 3. They must not be tied too tightly. 4. Too much force must not be used in reducing the invagination, or the sutures may cut out. 5. In closing the longitudinal incision, too much of the edges must not be turned in, or a contraction may result.

While this method is less alluring than Murphy's button, and cannot be used so rapidly, it has certain **advantages** over it which it shares with circular enterorraphy, and certain peculiar to itself. Thus, it needs no mechanical device, which may not be at hand just when wanted. It requires only a few needles, silk or horsehair. Thus, in Dr. Wiggins's account of his own case, in which he resected six inches of the ileum for contusion and perforation, uniting the ends by Maunsell's method, he writes (*loc. supra cit.*): "The urgency of this case was great. The patient was in a country farmhouse. The operation could not have been safely delayed one hour longer than it was; consequently, there was no time to procure mechanical devices from the city. A few instruments, a paper of ordinary sewing-needles—milliners' No. 6—and some iron-dyed silk were easily procured, and the operation was promptly performed, and the patient's life saved."

FIG. 63.



This shows the line of junction, the peritonæum well turned in, and the sutures and knots nearly all inside the gut. One or two sutures are seen in the mesentery. G and H as before. Above H would be the longitudinal slit sewn up by a continuous suture.

The advantages which are claimed over circular enterorraphy are that this modification is speedier of execution, and that it gives easier command over the hæmorrhage. A third is that, when the ends are of unequal size, they can be more readily dealt with by the invagination of this method than by circular enterorraphy. The chief objection to be brought against it is the additional wound through which the temporary invagination has to be made. Having compared this method with Murphy's button (p. 236), it is right that I should add that Dr. Ricketts,

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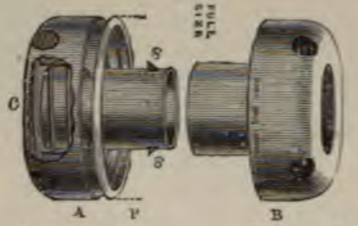
[*] If, now, there is any doubt about the line of suturing, a few Lembert's sutures should be added externally, especially about the mesenteric junction; or an omental graft (p. 267) may be added (Stanley Boyd, *Med.-Chir. Soc. Trans.*, vol. xxvi. p. 345).

of Cincinnati (*Ann. of Surg.*, vol. i. 1894, p. 473), after resecting four inches of the ileum for carcinoma, on attempting "to make a Maunsell operation," found that the distal end of the gut was so fixed, it being only five inches from the ileo-cæcal valve, that more time would be consumed than was for the good of the patient. He accordingly used the Murphy's button, which took only eight or ten minutes. The patient, who had persistently refused operation, sank ten hours later. Dr. Ricketts, while "satisfied that the button was the most appropriate in this case," is "thoroughly convinced that the Maunsell operation is the one to be used in the majority of cases."

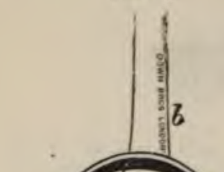
Murphy's Button (Figs. 64 to 67).—This, one of the most ingenious inventions of the last century, we owe to Dr. J. B. Murphy, of Chicago (*New York Med. Record*, Dec. 10, 1892). Its great advantage is the facility and rapidity with which end-to-end approximation can be effected without any sutures. The button consists of two halves. The male half has a spring flange for keeping up pressure on the intestine ends. Two springs (*s, s*), projecting through openings in the hollow stem, act as a male thread of a screw, when the male half is telescoped within the female half of the button. When the button is used to unite resected ends of bowel† a puckering or running thread is passed round each side to and from the attachment of the

FIG. 64.



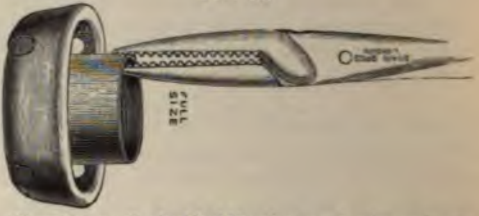
Murphy's button. A, Male half. B, Female half. F, Spring-flange. *s s*, Springs projecting through openings in hollow stem. At *c*, part of the cap of the small half has been cut away to show the circular spring which keeps up the pressure as the button does its work. The round holes in the caps are for drainage. (This and the next three figures are borrowed from Down's pamphlet, 1894.)

FIG. 65.



b, Puckering thread. *a* shows the return-stitch by which the interval between the two layers of the mesentery is closed—a very important detail.

FIG. 66.



Showing method of holding button for insertion.*

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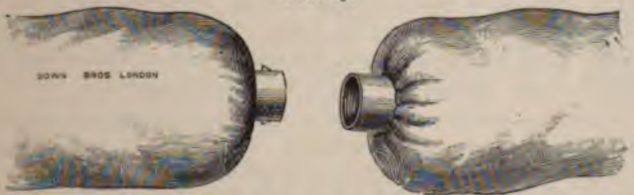
* The male half of the button is held in the same way. The figure representing the forceps holding the male half of the button has been omitted, as it shows the forceps in a wrong position. Mr. Cathcart, of Edinburgh, has kindly drawn attention to this point.

† Its use in effecting lateral anastomosis is given at p. 269.

mesentery, and especial care is taken to close the triangular interval which exists here (Figs. 59 and 65), by means of the return stitch. One half of the button, held as in Fig. 66, is then inserted in the intestine, and the running thread so tightened as to pucker the cut end of the intestine with sufficient closeness and tightness around the shaft of the button. The ends of the thread are then tied and cut short. The other half of the button having been secured in the opposite end of the intestine (Fig. 67), the two halves are gently pressed together, the surgeon having first made sure that both cut ends are, all along their edges, within the grasp of the button. The two halves are pressed together until it is seen that the peritonæal surfaces are held in sufficiently close and accurate contact. Dr. Murphy holds that it is needless to apply Lembert's sutures with the button between the serous surfaces, and that scarification of these is also unnecessary.*

Dr. Murphy (*Lancet*, vol. i. 1895, p. 1040) claims for his button that in resection of intestine for gangrenous hernia it has been used twelve times with two deaths. In resection for malignant disease there have been thirty operations with seven deaths, these thirty including eight cases of resection of the cæcum with but one death. With regard to two of the cases of fatal peritonitis, Dr. Murphy points out that in one the button was too large and fitted too tightly. To prevent tension the button should fit easily. In another case both ends of the intestine were found to be gangrenous at the necropsy. This is stated to have been due, not to the button, but to the length of time during which the intestine was clamped during the operation.

FIG. 67.



Murphy's method of end-to-end approximation of divided intestine. The two halves of the button, each secured by a puckering thread, are ready to be pushed home.

The *modus operandi* of the button is based upon the following principles: (1) It retains apposition automatically—that is, without suture. Thus the danger of shock, the length of the manipulation and exposure of the intestine, the risk of infection, post-operative paralysis, and adhesions, are very greatly lessened, and an immense saving of time secured. (2) The pressure-atrophy is produced by elastic pressure; this being uniform and continuous, the assurance of adhesions is greater and the risk of infiltration less. It produces juxtaposition of the edges of the same coats, thus minimising the interposition of fibrous tissue, and perfecting the regeneration along the line of union. As a result, the union is accomplished with the smallest possible cicatrix, and therefore must yield the least contraction of any operation. Believing that he had absolutely established the above, Dr. Murphy claimed that his button attained the best results in intestinal approximation because it best attained the following ends: (*a*) Accurate contact of surface. (*β*) Speedy and permanent adhesion of the approximated surfaces. (*γ*) An opening sufficiently large for immediate purposes. (*δ*) A cicatrix that will not contract harmfully. (*ε*) The accomplishment of all these in the most *simple* and *rapid* manner.

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* The following precautions are given as to the button and its use. The edge of the cup should never be sharp, but possess a line of surface. The spring must not be too stiff, or it might produce too rapid sloughing. The locking should be easy. Unnecessary handling of the buttons should be avoided. They should be left partially unscrewed, until wanted for use.

Objections.—Dr. Murphy's method is so alluring in its ingenuity, the simplicity and readiness with which it can be applied are so evident, that there is some danger of its **disadvantages** * being lost sight of. The following appear to me to be established:

(1) Contraction of the orifice.† When the *modus operandi* of the button is considered this risk must always be remembered. In the words of an American surgeon who has taken much practical interest in intestinal surgery (Dr. McGraw, of Detroit): "In the operation by Murphy's button, the button becomes detached by crushing the rim of tissue around the opening of communication until it sloughs and gives way, leaving behind a granulating wound, disposed to close after the nature of such wounds" (*Ann. of Surg.*, vol. ii. 1893, p. 315). A case of Prof. Keen's, of ileo-colostomy, for carcinoma of the colon, by means of the button, is an instance of the truth of the above:

The button had been passed on the twelfth day, "together with a slough consisting of the rings of tissues between the two halves of the button. The patient died very suddenly of a perforating ulcer of the colon, forty-seven days after the operation, and the necropsy showed that the opening had already contracted to one-half of its original diameter.

Prof. Keen considers the possible contraction of the anastomotic opening "the pivotal point upon which rests the utility of the button."

Dr. Dawbarn, of New York, a strong advocate of vegetable plates in intestinal surgery, had earlier (*Ann. of Surg.*, vol. i. 1893, p. 155) expressed a fear which this case of Prof. Keen's proves to have been well grounded: "In performing cholecystenterostomy it (the button) really seems an ideal plan; but upon stomach and in uniting bowel to bowel, because of the primary small calibre of the new opening (still further to be reduced with time), I venture to predict a justified lack of acceptance by the profession." The following case of Dr. R. Abbe, of New York (*Ann. of Surg.*, April 1895), shows that even after cholecystenterostomy such stenosis may follow as to prevent fluid contents such as bile from passing:

About a year before, Dr. R. Abbe had opened the gall-bladder, establishing a fistula in a woman who had cancer involving the head of the pancreas and first part of the common duct, causing obstruction and distension of the gall-bladder. The patient's condition having greatly improved in six weeks, Dr. Abbe established an anastomosis between the gall-bladder and duodenum with a Murphy's button. This was passed on the twelfth day. The patient remained in excellent health for eight months, when symptoms of gall-stone colic recurred, making it probable that stenosis was taking place. The symptoms returned, and the patient died in the third attack with cholæmia and convulsions. The opening created between the gall-bladder and duodenum had become absolutely closed by cicatricial contraction ten months after its establishment. The malignant disease had not invaded the anastomosed parts.

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* Dr. Murphy, in a very interesting paper on "Operations with the Murphy Button" (*Lancet*, vol. i. 1895. p. 1040), makes, I think, too light of these. Several of his conclusions as to contraction of the scar left by the button, fæcal impaction, and sloughing, are, it seems to me, not justified by the published cases (*vide infra*).

† Dr. Murphy (*loc. supra cit.*) states first amongst the conclusions at which he has arrived—"The cicatrix produced with the button does not contract." No mention is made of Prof. Keen's case given below.

(2) Sloughing at the line of junction, and extravasation of fæces. The following case of Dr. Abbe's (*Ann. of Surg.*) is a proof of the risk of the above:

The patient was admitted with obstruction due to carcinoma of the sigmoid. Owing to the distension and the condition of the patient, a lateral anastomosis above and below the cancer was done with a button. Six weeks later, resection was undertaken, owing to the pain felt locally. The anastomosed gut was resected, and an end-to-end anastomosis made "by a large button which fitted rather snugly in the lower end." The cancer had by this date invaded the lumbar wall. A counter-opening was made behind, and the anterior one closed. On the fourth day, fæces appeared at the lumbar wound. On the sixth day this was freely opened, and the intestine found to be sloughing on either side of the button. On the seventh day the patient died exhausted.

It is only fair to Dr. Murphy to point out that this was a very severe test for his method. The patient was "not in very good condition after the operation," and it is possible that the separation of adhesions and the extension of the growth had interfered with the blood supply of the intestine, though this is not stated.

Moreover, the button was undoubtedly a large one, for it "fitted rather snugly," and in this lies the answer to the above objection, for a button which in any degree stretches the intestine will be liable to cause sloughing opposite the outer rim. This has undoubtedly been the cause in other cases where this accident has happened.

(3) Septic peritonitis due to sloughing of the intestine over the button. When we consider that in anastomosis of the intestine we can never keep the field of operation aseptic, and that, whatever method we use, needles, sutures, plates, buttons, &c., may all be the means of increasing sepsis, no surprise will be felt when occasionally cases are published in which septic peritonitis has followed on the use of the button. Its *modus operandi* is by setting up a limited pressure-gangrene or sloughing. In many cases this process will be limited, but it is manifestly impossible to control or limit such a process, and occasionally fatal results will be met with from this cause.

Mr. Harrison Cripps (*loc. supra cit.*) mentioned a case in which the patient died in two or three days from acute septic peritonitis due to sloughing of the intestine over the upper half of the button.

Prof. Senn speaks very strongly on this point (*Journ. Amer. Med. Assoc.*, vol. ii. 1893, p. 232): "It is impossible to effect an aseptic incision in the interior of the bowel; the dead tissue inhabited by pathogenic microbes always constitutes a source of danger. It is easy enough to produce gangrene, but we are powerless in limiting its extension in this locality. The limited area of living tissue brought in contact outside of the rings of the Murphy button will not always prove adequate in the protection of the peritonæal cavity against perforation and its immediate result—septic peritonitis. I have knowledge of a number of cases in which the parts approximated by the Murphy button were found completely separated at the post-mortem examination."

(4) Retention of the button, causing obstruction. I shall allude to a case, under the heading of Gastro-jejunostomy (p. 331), where the button had not been passed but no harm had followed. A number of similar cases have been recorded.

The following show that the button may cause fatal obstruction:

Dr. R. Abbe (*Ann. of Surg.*) has related a case of resection of the caput coli and ascending colon for cancer in a patient aged 42. An end-to-end anastomosis was easily made with a medium-sized, easy-fitting Murphy button. At the end of the second day there was abdominal pain, with tympanites and vomiting. Strong desire to defæcate was futile, even with the aid of a high enema. Saline cathartics were useless. On the third day after the operation the greatly distended ileum was sutured to the abdominal wall and opened. A large amount of fluid fæces escaped with great relief. The patient died on the sixth day. The necropsy showed no peritonitis, but an empty colon below the button, and a hard plug of fæces in the button, which caused complete obstruction.

Dr. Kammerer (*Ann. of Surg.*) has recorded a case in which the button caused trouble by not passing in the small intestine.

The case was one of fæcal fistula, resulting from a gangrenous hernia. Anastomosis had been made by a Murphy's button. Thirteen weeks later the button had not been passed, but could easily be reached from the fæcal fistula which still persisted. Dr. Kammerer enlarged the fistula, and after much trouble succeeded in extracting the button. The patient did well for six days, when she developed symptoms of sub-acute peritonitis and died. The necropsy showed general peritonitis. The anastomosis had separated while the button was being removed, and the sharp edges of the incision into the bowel showed that the adhesions, even after thirteen weeks, must have been very slight. Dr. Kammerer did not believe that the peritonitis was due to a separation at this point, but any other explanation for it was not apparent.

Mr. Harrison Cripps (*Brit. Med. Journ.*, vol. ii. 1895, p. 965) mentioned, in the discussion on Colectomy, a case in which the patient died on the eighth day from perforative peritonitis caused by the button having become impacted six inches below the point of anastomosis, and having ulcerated through.

(5) Kinking and strangulation from the weight of the button. This is rare, but a case of Dr. Abbe's is related of this kind (*Ann. of Surg.*):

Five inches of small intestine had been resected for gangrene in a hernia. The two ends having been joined by Murphy's method, the loop containing the button was replaced, and Bassini's operation performed. Before the wound was entirely closed, Dr. Abbe looked in and noticed that the upper end of the gut was still distended. This was due to the button kinking the gut as it lay in the iliac fossa. The loop was accordingly pushed towards the middle of the abdomen, in the belief that it would settle and rest easily among the other coils. Symptoms of strangulation recurred, and forty-eight hours after the first operation Dr. Abbe reopened the abdomen and found the kink persisting, the bowel having gravitated to the lowest point in the pelvis. The patient only survived the operation a short time. It seemed that the weight of the button had given rise to the acute obstruction by sharply bending the gut. Probably this was aided by the paralysed condition of the bowel so common in these cases.

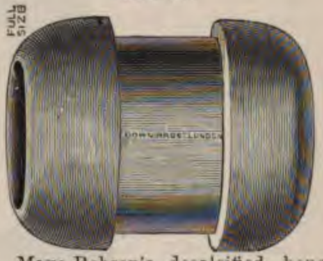
(6) Mr. Mayo Robson, in a speech at the Clinical Society, pointed out that if any error was made in applying the button, it might be impossible to unfasten it for readjustment. He stated that under such circumstances an operator, in order to set the button free, had found it necessary to excise afresh the portion grasped by the button.

(7) Another objection of a very different kind may be just alluded to, and that is, its expense, and the difficulty of always having the right size at hand. This in no way detracts from the ingeniousness of the button, nor do I bring it forward as a serious objection. It is right, however, that it should be mentioned when this mode of intestinal junction or anastomosis is fairly weighed with enterorraphy, Robson's bobbin, &c.; this last is, of course, required in several sizes, but, being far less expensive, will be more readily near at hand in sufficient variety.

I am well aware that these cases given above are but few when compared with the large number of brilliant successes which Dr. Murphy's button has attained. It is right, however, that they should be published, as there is strong reason to believe that the button has been used on many occasions unsuccessfully, these cases never being published. Again, it is noteworthy that the failures which have been published have occurred in the hands of most skilful surgeons. I fear that the extreme ingenuity of the button, the facility with which it can be used, may tempt men far less competent to perform operations for which they are unfitted, with results that will not be made public. König (*Centr. f. Chir.*, No. 4, 1895), I find, has expressed the same view. Thus, "The use of Murphy's button may extend the practice of resection, and so enable inexperienced surgeons to perform these operations, but this, from the patient's point of view, is rather a disadvantage than a sign of advance."

Mayo Robson's Bobbin (Figs. 68, 69, 70).—This method appears to me likely, for the present, at all events, to replace all the other special apparatus which have been invented to aid in the resection or anastomosis of the stomach and intestines.

FIG. 68.



Mayo-Robson's decalcified bone bobbin. These are made in five sizes, for junction of gall-bladder and intestine, stomach and intestine, to unite resected small intestine, colon, and rectum. The above is the size used for the colon.

Mr. Robson (*Brit. Med. Journ.*, vol. ii. 1895, p. 963) states that, after using or seeing used all the other usual contrivances, *e.g.*, Senn's plates, Murphy's button, and Paul's tubes, he has returned in enterectomy to the use of the bobbin, which "I infinitely prefer, not only on account of its simplicity and safety, but because it can be employed quickly, secures an immediately patent channel, leaves no foreign body permanently in the passage, avoids stricture by securing continuity of mucous surface, and can be adapted to any of the operations on the intestinal canal."* Another advantage which may be safely claimed is that these bobbins are much more easily introduced when one segment of intestine, *e.g.*, the lower usually, is much narrower than the upper. Again, from their shape, they obviously will exert much less tension upon the intestinal wall and the sutures which hold them together, than the plates o Prof. Senn.

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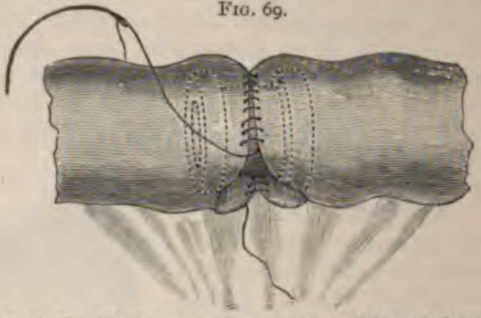
* It will be a very great gain if surgeons find, as claimed by Mr. M. Robson (*La Semaine Médicale*, 1892, p. 482), that there is one contrivance ready to their hands calling for much the same technique in all such varied operations as enterectomy, intestinal anastomosis, ileo-colostomy, pylorectomy, pyloroplasty, cholecystenterostomy.

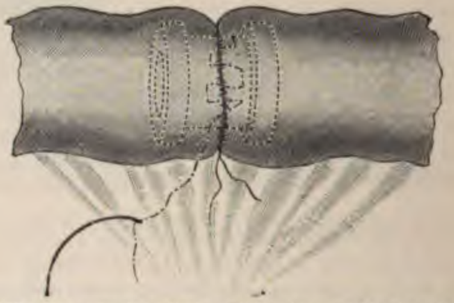
The decalcified bone bobbins were in their first issue like a cotton-reel, the rims at the ends being (Fig. 69) made larger than it centre in order to prevent the body shifting from its place until it pressure is not needed. These rims being found too prominent, the bobbin was modified as shown in Fig. 68. The following account i taken from *La Sem. Méd., loc. infra cit.* (Figs. 69, 70): "It seeme that if one could secure continuity of the mucous coat across the nev aperture by means of a continuous suture (Fig. 69) sewn around a tub without the risk of narrowing the size of the orifice, one would be abl to avoid consecutive cicatricial narrowing. The union of the serous

FIG. 69.



The continuous muco-mucous suture (Mayo Robson.)

FIG. 70.



The continuous sero-serous suture. Below is seen the knotted end of the muco-mucous stitch which will shortly be shut in. (Mayo Robson.)

surfaces could be assured by means of a sero-serous suture made in th same way as the mucous, one or one and a half centimetres from the edge of the incision, so removing all risk of extravasation (Fig. 70). Th operation is facilitated by beginning with the sero-serous suture for th posterior half of the incision, then putting in the muco-mucous for th same extent. The tube is then put in place, the muco-mucous sutur next completed, and finally the anterior half of the sero-serous."

Mr. Mayo Robson (*Brit. Med. Journ.*, vol. ii. 1895, p. 965) stated tha while usually employing two sutures, the mucous and serous, with hi bobbin, he has not hesitated to use only one continuous stitch to unit the whole thickness of the gut where time was an object in the case

In this case he claims that the bobbin-operation can be done more quickly than that with the button, and at the same time he believes that it will give greater security against leakage and a much firmer bond of union. When the double suture is used, Murphy's button will, Mr. Robson thinks, only save three or four minutes, and he points out that his five cases of colectomy are living examples of the contrast of the after-progress of the two methods. Thus in cases i. ii. and v., where the bobbin was used, an uninterrupted recovery followed; in case iii., Murphy's button took forty-four days to pass, and caused partial obstruction on several occasions. In a list of cases which Mr. Robson prepared in order to illustrate a paper read before the Clinical Society (*Brit. Med. Journ.*, vol. i. 1896, p. 451), the bobbin was used in seven cases of enterectomy, and out of these six recovered.*

The following **advantages** of this method have, it seems to me, been fairly established :—(1) It facilitates and simplifies circular enterorraphy. (2) The foreign body on which it depends is safely dissolved, instead of being left behind to come away, thus often giving rise to anxiety. (3) There is no sloughing connected with its *modus operandi ;* it prevents subsequent stricture by establishing a continuous mucous canal, without the stage of healing by granulation. (4) Owing to the size of the bobbin, and there being no sloughing connected with it, the opening provided is sufficient and permanent. (5) Though at present it has not been very largely used, the percentage of successes is very high. In his paper, read before the Clinical Society, Mr. Robson showed that the use of the bobbin had been attended by a mortality as low as 8 per cent. (6) Last, but by no means least in importance, is the fact that the bobbin is adaptable to a very wide range of operations. The only **objection** to it is one common to all mechanical devices—*i.e.*, that it is not always to hand. In, however, its cheapness, its great variety of sizes, and the readiness with which it can be prepared, it contrasts very favourably with Murphy's button, while from its greater facility of introduction, absence of somewhat perplexing threads, and the safer tension it exerts upon opposed or approximated segments, it seems to me to be a distinct advance upon the bone plates of Prof. Senn, making all due allowance for the excellence of the work which these earlier devices of a very brilliant pioneer in abdominal surgery have done.

Allingham's Bobbin (Figs. 71 to 74).—Mr. H. Allingham has introduced a bone bobbin which differs from Mr. Robson's in shape and structure. It consists of two cones with the apices united in the centre (Fig. 71). They are decalcified to within about three-sixteenths of an inch of their centre. The junction of the two cones is hard and unyielding to meet any pressure from the sutures when tightened. Besides the advantages of other bobbins it is claimed that this one cannot slip away, and that when the sutures are tied the parts resected are brought together without excessive pressure on the edges of the bobbin. A purse-string stitch (Fig. 72) is run round each end of the gut: then one end of the bobbin is inserted into one segment of the intestine, and the suture is pulled tight by a knot twice threaded (Fig. 72), which

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* Mr. Bowlby, in the discussion which followed Mr. M. Robson's paper, emphasised the advantage of the bobbin in securing the immediate passage of flatus and fæces.

will not slip, but the final tie is not made until the other end of the bobbin has been inserted into the other segment of intestine. After this each suture is tightened to its utmost, the ends of the intestine being thus drawn down to the centre of the bobbin (Fig. 74), which from its shape ensures that the tighter the sutures are drawn, the more securely must the intestine ends be drawn to meet in the centre of the bobbin. A few Lembert's sutures or a continuous Lembert's suture may be used if thought desirable. It is well to lightly scarify the serous coat for half an inch round the union to promote exudation of lymph. This button has been successfully used once on the human subject by Mr. Allingham.

Fig. 71.

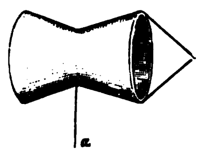


Fig. 72.

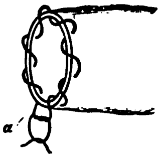


Fig. 73.

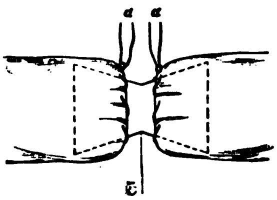


Fig. 74.

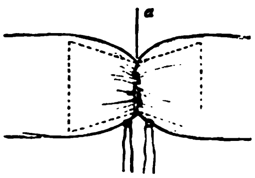
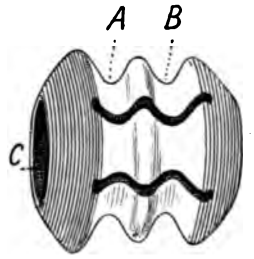
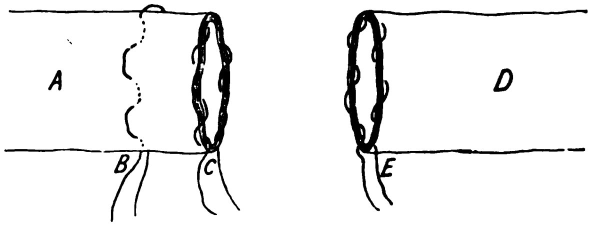


Fig. 75.



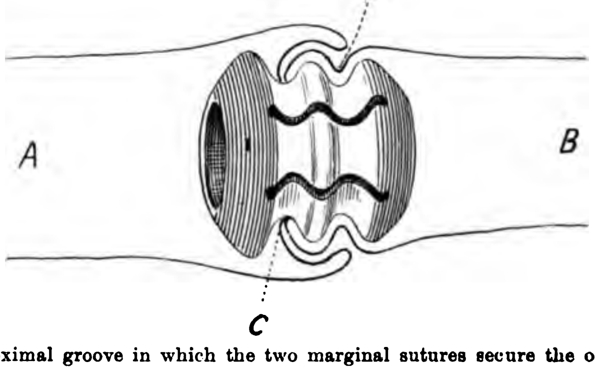
A B, Central part not decalcified, partly segmented by saw-cut. C, Lumen in decalcified end.

Fig. 76.



A D, Proximal and distal intestine. C E, Purse-string sutures. B, Sub-serous purse-string suture, by which, after union of the intestine, one part is invaginated over the other.

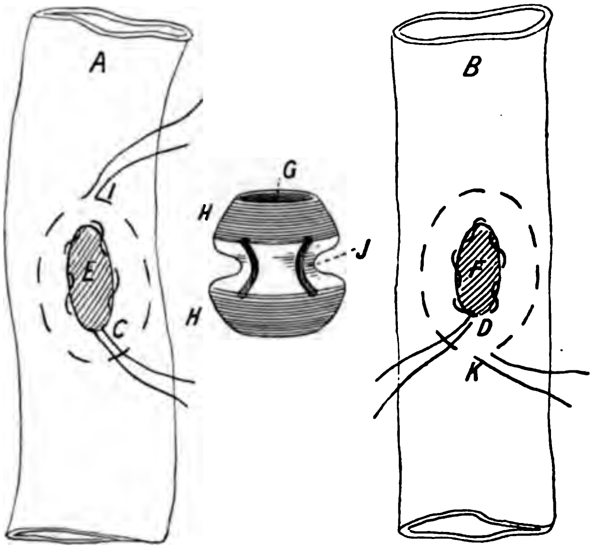
Fig. 77.



C, Proximal groove in which the two marginal sutures secure the orifices of the two parts of the intestine, A and B. D, Distal groove where sub-serous purse-string presses the proximal intestine over the invaginated distal part.

Hayes' Bobbin (Figs. 75 to 78).—Mr. Hayes has devised (*Lancet*, vol. i. 1895, p. 1619) another ingenious button, partly decalcified, by which he obtains additional security by easily invaginating one piece of resected intestine within the other. It is not stated whether the bobbin has been successfully used on the living subject. The drawings are so clear that they explain this method of themselves.

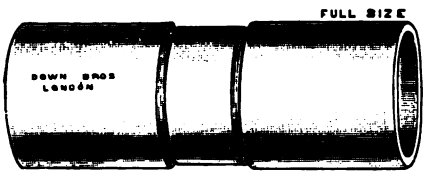
Fig. 78.



Lateral anastomosis by Hayes' bobbin. E and F, Apertures to receive the bobbin. D and C, Marginal sutures. K and I, Sub-serous purse-string sutures.

Bailey's Decalcified Bone Tube.—Mr. R. Cozens Bailey describes (*St. Barth. Hosp. Reports*, 1897) two successful cases in which he made use of the tube shown in Fig. 79. The first case was one of resection of six inches of gangrenous small intestine from a strangulated inguinal hernia; the second, one of artificial anus of long standing.

Fig. 79.



Bailey's decalcified bone tube.

The method of using the tube and the advantages claimed for it are best described in Mr. Bailey's own words:

"The intestinal contents being kept back by two pieces of rubber drainage-tube passed through the mesentery and tied round the bowel some distance above and below the site of operation, so as to be out of the way, and the necessary amount resected, a single stitch is passed at the mesenteric border through the whole thickness of both ends of the gut, and tied, thus bringing the divided extremities together at their attached margin. This is important, as it not only prevents the peritonæum being stripped back, but also greatly facilitates the application of the circular ligatures at a subsequent stage of the operation. The tube is now passed into the bowel, and when in position one end of the gut is brought well down over its corresponding groove and secured by a silk ligature passed through the gap in the mesentery, and made to encircle the whole circumference of the bowel in such a way that when tightly tied it lies within the groove. The part beyond the silk is then trimmed with scissors, so that only just sufficient is left to ensure the ligature holding. The other end is then treated in the same way. A little difficulty may be experienced here in getting the ligature to include the whole thickness of the intestine, the part most liable to escape being the mesenteric border; but this entirely disappears if two little points which I have insisted upon be observed: firstly, the preliminary tying together of the ends by a suture at the mesenteric attachment; and secondly, the inclusion of a sufficient length beyond the circular ligatures, the excess being subsequently removed with the scissors.

"At this stage the operation site should be thoroughly flushed with an antiseptic solution in order to remove any particles of fæcal matter, &c., which may be present. The assistant now grasps the intestine at a little distance from the ligatures, and by approximating his hands, brings the serous coats into contact in such a way that, if the proximal and distal portions of the gut are of equal calibre, a point an eighth of an inch above the upper meets a point a corresponding distance below the lower ligature, over the centre of the space between the grooves on the tube. If, however, there is great inequality in the sizes of the two portions of intestine, the smaller can be invaginated into the larger, and, as I previously pointed out, probably this manœuvre would be more easily carried out by using a conical instead of a cylindrical tube.

"The serous coats thus approximated are fixed in position by a row of Lembert's sutures. In the case of small intestine, five or six of these only will be required, one on each side close to the mesentery, which should be passed first, the remaining three or four round the rest of the circumference. The chief advantages which I claim for a tube of this sort are—

"(1) That it provides the largest possible temporary channel for the passage of intestinal contents.

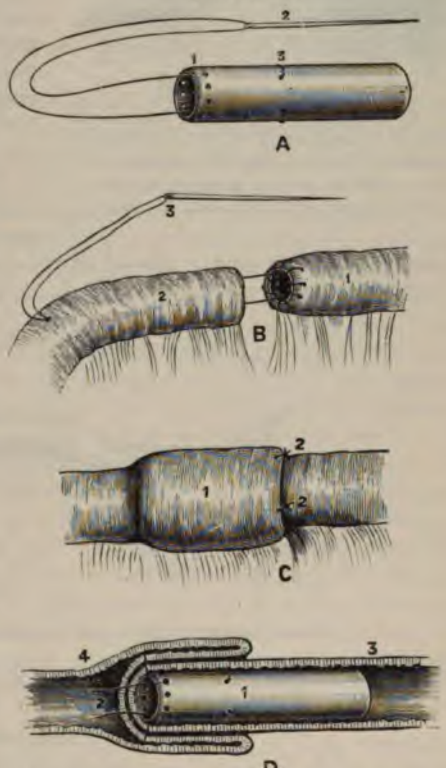
"(2) That till it softens, or the ligatures cut through, the escape of fæcal matter is absolutely prevented.

"(3) That since the row of sutures takes no part in keeping the junction water-tight, a sufficient number to keep the parts in apposition only is required; and these being few and easily introduced, the time required for the operation is greatly diminished.

"(4) That the tube, having fulfilled its purposes, undergoes absorption and leaves no bulky mass to pass along the canal."

Paul's Method (*Liverpool Med.-Chir. Journ.*, July 1892). (Figs. 80 to 83.)—This method has only a limited application, but is described in honour of its originator. End-to-end union of divided intestine is brought about by invagination aided by a bone tube. The method is as follows:—First the operator is prepared with a decalcified bone tube, like that shown in Fig. 80, A, to which is attached a needle and a strong silk thread, called the traction-thread. The tube is required chiefly to enable the operator to produce an invagination of the bowel which will cover the line of union; but it is also useful for keeping open the channel of the intestine, and as a splint to keep the parts quiet during the early stages of repair.

FIG. 80.



A. The decalcified bone tube. 1, The lower or distal end perforated for sewing to the bowel. 2, The traction-thread armed with long sewing-needle. 3, Its attachment to the tube.

B. A further stage in the operation. 1, The proximal end of the bowel with the tube sewn in. 2, The distal end not yet sewn to the proximal, but (3) the traction thread has been passed.

C. The operation completed. 1, The sheath or intussuscipiens of the invagination. 2, The Lembert sutures for retaining the parts in position.

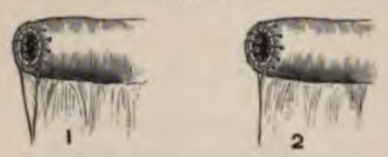
D. The parts, shown in section. 1, The tube *in situ*. 2, The traction-thread cut short. 3, The proximal end of bowel entering the intussusception. 4, The distal end supplying the returning and ensheathing layers. (Paul.)

The piece of bowel having been excised, the tube is sewn into the upper end: with a continuous suture of chromic gut or silk passing through the holes in the tube and taking up the serous and muscular coats of the bowel, the traction-thread is then passed through the wall of the lower segment about three inches down, as in Fig. 80, B. Next, the two cut ends of bowel are quickly attached to each other with a continuous silk suture. An assistant now draws firmly on the traction-thread, whilst the operator produces a short invagination which is retained in position by three or four Lembert's sutures (Fig. 81, C, 2, 2). Finally, the traction-thread is drawn tight and cut off short, its end dropping into the bowel.

It is claimed for this operation that—(1) the closure is absolutely secure as long as the bone tube remains intact, or until sloughing has had time to occur; (2) a free passage is at once established; (3) the opening does not subsequently diminish or contract. The bone tube is gradually disintegrated, and will probably not be seen again.

When invaginating, an error must be guarded against. The invagination is most easily produced by allowing it to commence about half an inch or so below the tube (Fig. 83). This means that the cut will be barely covered by it, whilst the lumen of the bowel will be considerably blocked, and the operation consequently most imperfectly performed. It must be made to commence *immediately* below the tube by drawing the very first part of the lower segment upwards with the tips of the fingers (Fig. 82), and care must be exercised to observe that the mesenteric side of the bowel is as thoroughly covered by the invagination as the other side.

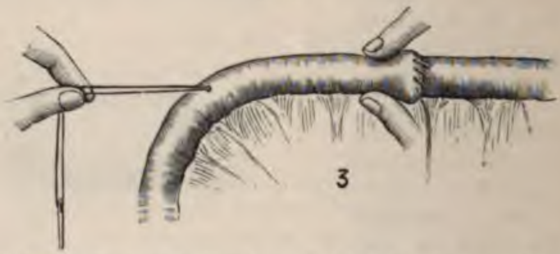
FIG. 81.



1, Showing the cut mesentery improperly allowed to gape. 2, The mesentery drawn together; but the diagram wrongly indicates a stitch passing through the bowel *without* piercing the mesentery. (Paul.)

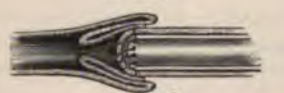
Mr. Paul has made use of this method with brilliant success in two cases of resection of gangrenous small intestine in femoral hernia (*loc. supra cit.*; *Clin. Soc. Trans.*, 1892; *Brit. Med. Journ.*, vol. i. 1894, p. 235). Mr. Horrocks, of Bradford, has also used this method most successfully in a case of resection of intestine for sarcoma. About thirty-nine inches were removed, but the exact position is not given. It is noteworthy that as in this case and Mr. Paul's second one, owing to the dilated condition of the upper part of the intestine, it would have been difficult to invaginate the upper into the lower bowel, the lower was invaginated into the upper without ill result.

FIG. 82.



Producing the invagination *immediately* below the cut. (Paul.)

FIG. 83.



The invagination carelessly produced. The lumen of the bowel is partly closed, and the line of suture barely covered. (Paul.)

Mr. Paul would only recommend his method for the small intestine, as most parts of the large are too fixed to admit of sufficiently free manipulation of the bowel.

Absorbable Plates.—The following substances have been used: (1) **Decalcified Bone,** by Prof. Senn; these are well known, and have been largely used. The mode of employing them is given in detail below, p. 271. (2) and (3) **Turnip** and **Potato.** These vegetable plates have been largely experimented upon in America and by a few Continental surgeons—von Baraçz, Heigl, and Butz—Dr. Dawbarn, of New York, seeming to have been the first to show experimentally that these vegetable plates could be used successfully (*Ann. of Surg.*, vol. i. 1893, and Magill, *loc. infra cit.*). A little later, but independently, von Baraçz, of Lemberg (*Centr. f. Chir.*, 1892, p. 575, and *Arch. f. klin. Chir.*, Bd. xliv. S. 513–591), published a series of experiments and some successful cases of gastro-enterostomy, in which plates of this material were made use of. We first have to consider the advantages and disadvantages common to all absorbable plates, and then to compare the plates of decalcified bone with those of raw vegetable.

When Prof. Senn, to whom modern surgery owes so much, introduced the principle (*Intest. Surg.*, 1889), the following were the chief **advantages** claimed: (1) To save time; (2) to do away with the evils resulting from too many sutures; (3) to secure a larger surface of approximation of the serous surfaces; and (4) to give complete rest to the parts which it is intended to unite.*

On the other hand, the following **objections** have been brought against the decalcified bone plates: (1) That they are expensive, tedious to prepare, and, as many sizes are required for various different contingencies, they are not likely to be at hand in an emergency;† (2) that the opening left is too small; (3) that they require for their absorption and disappearance several days after they have ceased to be needed; (4) that it is difficult to adjust the plates with the right degree of pressure when they are approximated. If they are tied too tight they will cause pressure-sloughing of the serous surfaces: on the other hand, if the plates are not held and approximated firmly enough, they may slide upon each other, and thus cause obstruction of the opening; (5) it is not easy to return the bowel and bone plates unless the opening into the abdomen is a free one. This has been found to be the case after making use of them for intestinal anastomosis for gangrenous hernia.

Of **Vegetable Absorbable Plates** I can say nothing at first hand, having never tested them or seen them used. They are strongly recommended by some American and one or two Continental surgeons (p. 248), who claim that these plates have all the advantages of Senn's bone plates, and others peculiar to themselves—viz.: (1) They are very cheap: (2) they are always at hand, being readily made out of materials —turnip or potato—which are easily obtained; (3) they quickly soften, and are absorbed when no longer needed; (4) they can be made with a large opening.

Laplace's Forceps.—The following description of this ingenious instrument is given in Dr. Laplace's own words (*Ann. of Surg.*, March 1899):

"The forceps consists of two parts which are really hæmostatic forceps curved into a semicircle on each side (Fig. 84); only, held together by means of a clasp, they open as two rings (Fig. 85). They are opened within the intestine, and serve the same purpose as Senn's rings or any other ring that has been devised, bringing serous membrane to serous membrane. Accurate suturing is the operation of the present. Ther fore if these forceps are within the gut and sutures are applied, as th would be with the help of Senn's rings, it follows that sutures are intr duced all round, except where the forceps penetrate the parts that a sutured. The suturing being done, the forceps are released by loosenin the clasp, and then withdrawing the forceps out of the small opening

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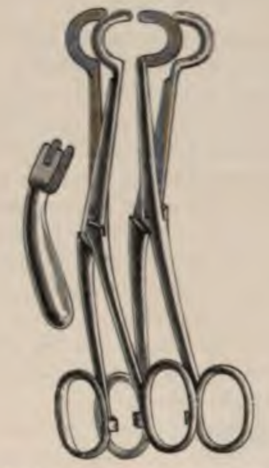
* A useful paper by Dr. W. S. Magill, of Chicago, on the results obtained by the use of absorbable plates, will be found in the *Ann. of Surg.*, Sept. 1894. Tables are given, and the writer maintains that in 87 operations there were only 20 deaths, a mortality of about 23 per cent., and that of these 20 deaths only one was due to the plates.

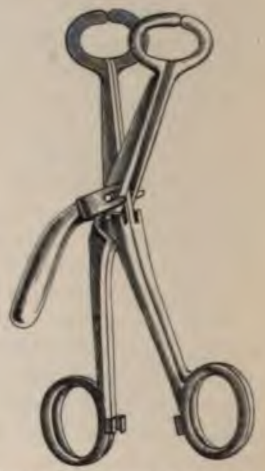
† Some surgeons have found that the plates are not easily preserved. I hardly think this fair to Prof. Senn. I have found no difficulty, by following his directions. Mr. Lockwood thus states his experience in characteristically terse and vigorous language: "My own experience of bone plates is as follows:—Intending to try them upon a suitable occasion, a bottle-full was obtained from the instrument maker. These dried up and became hard and horny. Others were procured, but they disintegrated and formed a kind of mud at the bottom of the jar" (*Med.-Chir. Trans.*, vol. lxxvii. p. 198).

FIG. 84.



The hæmostatic forceps bent into semicircles and clamp to hold them together.

FIG. 85.

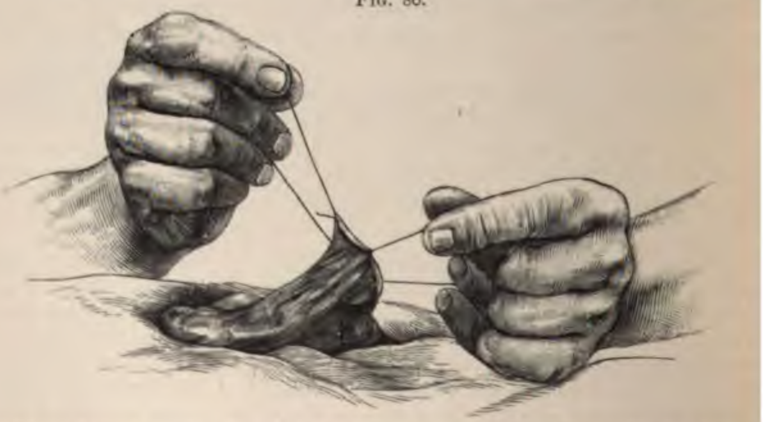


The forceps clamped together, and opened as two rings.

first one half, then the other, when the operation is finished by a stit or two."

The forceps may be used not only for circular enterorraphy but a

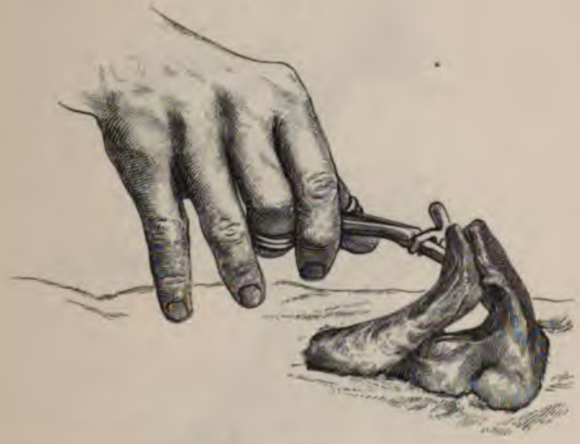
FIG. 86.



End-to-end anastomosis. Four fixation sutures are applied at the cardinal points, uniting the ends to be approximated.

for lateral anastomosis, gastro-enterostomy, &c., the instrument bei made in five different sizes. The advantages claimed are: (1) Rapidi and accuracy of suturing without leaving any foreign substance within the gut; (2) an absolute control of the field of operation by means of the assistance of the handles of the forceps; (3) the facility with which the forceps are applied, preventing the escape of intestinal contents during the operation.

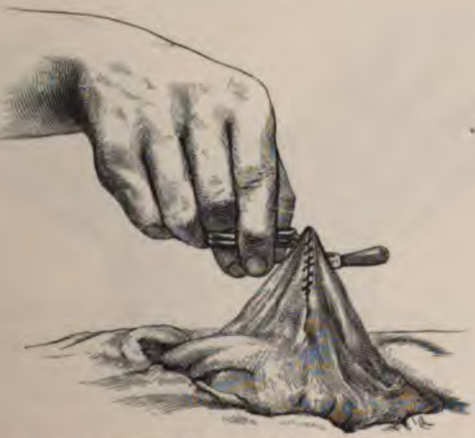
FIG. 87.



End-to-end anastomosis. The forceps is introduced between two sutures, and one blade is made to pass into each end of the gut.

End-to-End Anastomosis is performed as follows: "Having resected the required amount of intestine, the two ends are first united by a fixation stitch at the four cardinal points. This assures the right relation of the mesentery in the two ends of the gut. The forceps are introduced between two of these stitches. The blades are opened apart

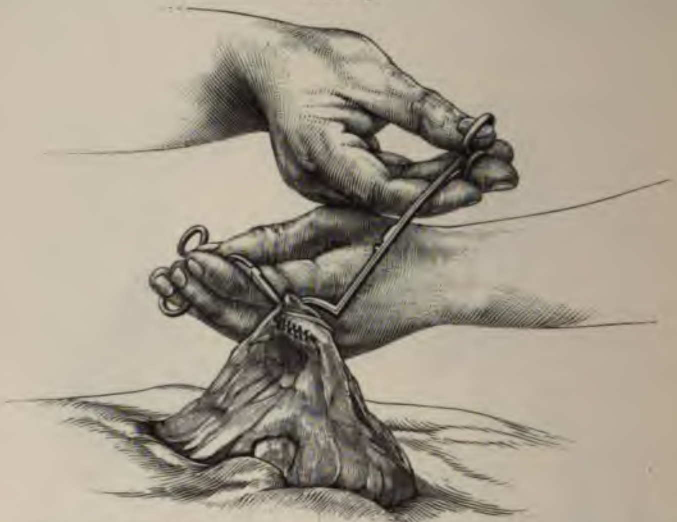
FIG. 88.



End-to-end anastomosis. The forceps is clamped, bringing serous membrane to serous membrane; sutures have been applied circularly.

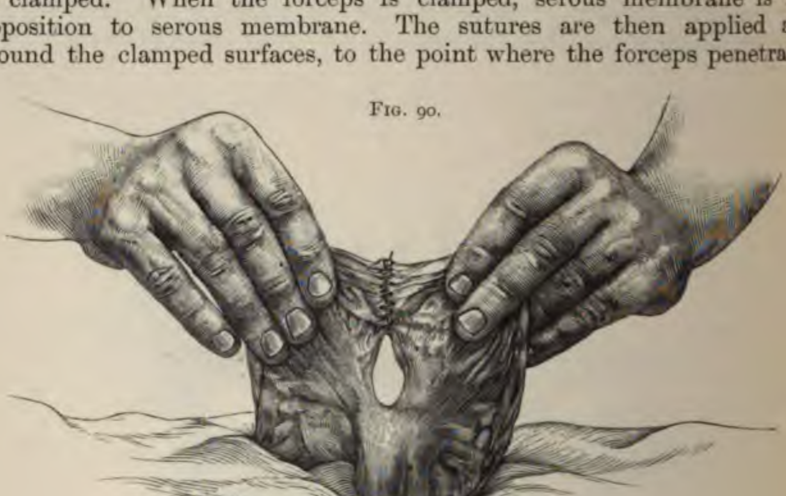
so that one penetrates one end, and the other the other end. The serous surfaces are inverted, or pushed in. This may be facilitated by drawing a thread around the united ends between the two blades. The forceps is clamped. When the forceps is clamped, serous membrane is in apposition to serous membrane. The sutures are then applied all around the clamped surfaces, to the point where the forceps penetrate the gut. The clamp is removed; one half of the forceps is removed; the other half is then removed. The operation is completed by adding

FIG. 89.



End-to-end anastomosis. One half of the forceps is being removed from small unsutured opening.

FIG. 90.



End-to-end anastomosis. The anastomosis is completed.

one or two stitches to close the opening through which the forceps were removed."

Comparison of Enterorraphy with the Chief Devices intending to Aid or Replace it.—Enterorraphy by circular suturing must be admitted to be the ideal operation from its simplicity, the entire absence of any especial apparatus, and the fact that no foreign body is left behind which may perhaps give trouble ere it come away. Those who condemn it as unsuccessful must remember (1) that it has been gradually and slowly perfected, being often laid aside for some new device and then resorted to again, and that it was very largely used in the earlier and darker days of intestinal surgery; (2) that when used by skilled hands it has proved most effective and reliable in the time of emergency.* When used by such hands—and it is one advantage of this method that it is easy for any operating surgeon to acquire skill in it—care will be taken to fulfil the conditions necessary for successful enterorraphy, viz.: (*a*) sufficient inversion of the serous coats; (*b*) sufficient penetration of the coats without perforation of the lumen of the intestine; (*c*) careful adjustment of the junction of the intestine and the mesentery (Figs. 59, 97, 99), and (*d*) placing of the sutures in healthy tissues.

It is right to state clearly here that many excellent judges, men well experienced in intestinal surgery, condemn circular enterorraphy. Thus Dr. A. B. Robinson (*Ann. of Surg.*, vol. i. 1891, p. 430) states that he found it, from experiments on dogs, very dangerous, for the following reasons: (1) It paralyses the gut, and hence does not so readily relieve the fæcal obstruction which is the immediate object of surgical interference. To this it may be replied that, as shown at p. 257, the joining of ends of intestine resected while obstruction is present should be deferred whenever possible; and when this is not possible—a rare contingency—the intestines should be thoroughly emptied before they are resected. If this is not practicable, union should be deferred and drainage continued by Paul's tubes (Fig. 54, &c.). (2) A fæcal fistula is apt to arise at the point of suture. (3) Gangrene or sloughing may arise from the pressure of numerous sutures. These are very fair criticisms. They must each be met by care in suturing, and by attention to the junction of the intestine and the mesentery. (4) The lumen of the two ends may be unequal. When this difficulty is marked, circular enterorraphy must be abandoned for intestinal anastomosis. (5) Pathological changes due to obstruction in the bowel may offer impediments. The gut may be stretched so thin that a needle cannot be passed between the muscular and mucous layers without danger of penetrating the mucous layer and causing fæcal fistula. I have pointed out elsewhere (p. 257) that union of resected intestine is not to be attempted where obstruction, over-distension, &c., are present. Where the distension has been prolonged, as in malignant disease low down in the canal, circular enterorraphy is contra-indicated. This is not the case where the obstruction has been of shorter duration—*e.g.*, in gangrenous herniæ—as shown by the successful cases given at p. 262. (6) Circular stricture followed the experiments. Some of the strictures were so severe that both fæces and gas were actually obstructed. (7) The long time required for a circular enterorraphy militates against the chances of recovery. Of all surgery in the world, intestinal surgery should be rapid and skilful. Of the different methods, Dr. Robinson recommends Lembert's sutures, making these continuous for two, three, or four stitches. This worked well and saved time, three to five interruptions of Lembert's sutures completing the circle round the gut. In this way a circular enterorraphy can be completed in less than half an hour. Dr. Robinson emphatically opposes a circular enterorraphy with a continuous Lembert's suture. "This was carefully tried, and the worst strictures of all resulted; not only that, but the thread gradually fell into the gut lumen, and its end dangled for days and even weeks there before it became entirely set free. This long thread will certainly be a dangerous source of infection, as infective fluids can go along it by mere capillary attraction, not to speak of the wider fæcal fistula it may create." There is much weight in these last two criticisms. An increasing number of recent successful cases of circular enterorraphy, amongst these being one by Lockwood (p. 262), three by McCosh (p. 262), one by Ransohoff (p. 262), and many by Continental surgeons, show, however, that they are not unanswerable.

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* To mention a few cases only, I refer my reader to those of Mr. Lockwood and to Dr. McCosh's four successful cases of circular enterorraphy after resection of small intestine for gangrene. To such urgent emergencies, circular enterorraphy is especially suited if the surgeon has had sufficient practice to rely on himself.

Messrs. Ballance and Edmunds (*Trans. Med.-Chir. Soc.*, 1896) have carried out an experimental enquiry with especial reference to the question of the best means of uniting resected intestine. The following, very briefly put, are some of the conclusions to which the authors were led with regard to enterorraphy, and other methods of resecting intestine. With regard to end-to-end union, the above-mentioned authors prefer simple suturing to the use of any form of supporting apparatus. They recommend either the Czerny-Lembert or Maunsell's method. Of five experiments on dogs performed by the former, and two by the latter method, all did well. With regard to the Czerny-Lembert method, emphasis is laid on the care needed at the mesenteric junction and on the following facts. In the small intestine eversion of the mucous membrane takes place to such a marked degree that the insertion of the inner row of sutures only results in apposition of mucous membrane to mucous membrane. Thus the integrity of the junction depends solely on the Lembert sutures. The result of the inversion produced by these is a ridge which remains at the line of junction, sometimes seriously contracting the lumen of the gut. This untoward result is especially likely to be brought about if the surgeon is uncertain about the efficiency of his row of Lembert's sutures, and is tempted to put in others, still further diminishing the lumen of the bowel. The above objection does not apply to Maunsell's method, which produces very perfect union, mucous coat being united to mucous, muscular to muscular, and serous to serous. After the Czerny-Lembert method a circular ridge or diaphragm is always to be found on laying open the intestine. This is not so after the Maunsell method: here it is quite difficult to recognise the line of circular junction, this presenting a marked contrast with the ridge seen at the site of the longitudinal incision which had been closed by Lembert's sutures.

Of the different methods of producing **lateral anastomosis**, Mr. Ballance and Mr. Edmunds consider Halsted's (Figs. 106 to 108) to be superior to all in which plates, bobbins, and other mechanical aids are used. The above-mentioned authorities emphasise one objection which applies to all of the above—viz., that the surgeon may very likely, in cases of emergency, not be provided with the size he requires. As to the claim that such devices shorten the time of operation, Messrs. Ballance and Edmunds reply: (1) That if, as in Senn's method of anastomosis, sutures have to be placed around the plates, the time taken is not much shortened. (2) Such a method as Halsted's lateral anastomosis does not take long if proper attention is paid to the following essentials: (α) A plentiful supply of round needles ready threaded with silk sufficiently thick not to cut the intestinal coats. (β) Using the needles as splints. Thus, if, just as one thread is coming to an end, the needle which carries it be left *in situ* transfixing the cut edges, this will keep the parts together and greatly facilitate the introduction of the next suture.

It is becoming increasingly clear, I think, that, in the hands of an operating surgeon who has taken care to acquire skill by practice, the chief objections to enterorraphy will be very greatly reduced—viz., the time taken, the number of sutures needed, the risk of perforating the lumen of the gut, of leakage at the junction of mesentery and intestine, and of stenosis from contraction of the cicatrix, especially if the inversion has been needlessly free.

Where the surgeon, from any want of faith in his skill, or from the condition of the patient requiring that the operation should be completed speedily, prefers to rely upon one of the devices intended to aid or to replace circular enterorraphy, he will be wisest in making use of Murphy's button or Mayo Robson's bobbin. Of these Murphy's button is highly to be recommended on account of the rapidity with which the operation can be completed. For although there are undoubted objections to the use of the button, as above described, careful adjustment in well-nourished intestine, and a wise selection in choosing the size of button to be used, will avoid most of them. Moreover, it must be remembered that the accidents that have happened are comparatively rare, and the results, as far as can be judged, are on the whole satisfactory. Comparison between Murphy's button and other methods of resection in the series of 226 cases of resection of intestine for gangrenous hernia collected by Gibson (*Ann. of Surg.*, Nov. 1900) is on the whole to the advantage of the Murphy button; for in the 63 cases in which Murphy's button was used there were 14 deaths, *i.e.*, a mortality of 22 per cent., while in the remaining 163 cases in which various other methods were made use of there were 44 deaths, or a mortality of 27 per cent.

Moreover, Sir F. Treves (*Brit. Med. Journ.*, Aug. 28, 1898) considers that the Murphy button is the best means of uniting divided intestine, having employed it in fifty cases with satisfactory results.

Mayo Robson's bobbin, by giving support, facilitates the suturing at the time and supplies some of the conditions which are at the root of Senn's excellent principle—viz., the giving support to the ends of the intestine by a body which will be safely absorbed. From its shape, and its simplicity in the absence of threads, I consider this bobbin more easily inserted and used in effecting a direct junction of the ends than Prof. Senn's plates and lateral anastomosis, while its ready applicability to a very large range of different operations puts it, in my opinion, on an equal footing with Murphy's button. Moreover, the part it is intended to play, and the material of which it is made, render it far safer than that most ingenious device.

The same absence of any threads to tie, and its wider applicability, make Mr. Robson's bobbin superior to Mr. Paul's decalcified bone tube, though, as I have stated at p. 248, several successful cases prove the efficiency of this device.

The choice may be said, therefore, to lie between direct suture or Maunsell's method, Murphy's button, and Mayo Robson's bobbin. Which of these methods will be finally judged to be the best is still uncertain.

RESECTION OF INTESTINE. ENTERECTOMY. COLECTOMY.

Indications for Resection Operations.—The chief of these are: (1) New growths. (2) Gangrene after strangulation in hernia or intestinal obstruction. (3) Injuries, gunshot or otherwise. (4) Some cases of irreducible intussusception. (5) Some cases of artificial anus where the canal of the intestine cannot be otherwise restored.

I propose to say a few words about the first two, the most frequent of the above indications.

The subject of Resection for Gunshot and other Injuries is fully dealt with in the next chapter.

(i.) **Indications for Resection in New Growths.**—In deciding between resection and one of the forms of anastomosis without resection, or between resection and artificial anus, the surgeon should pay particular attention to the following points, both local and general. The more they are present, the more favourable is the case. Small size, definite outline, especially if the growth approaches the annular form, free mobility as pointing to absence of adhesions, entire absence of that tenderness which points to peritonitis, or even to that breaking down and suppuration which may accompany new growths when they ulcerate and become septic, a situation in which the growth can be easily got at and isolated, *e.g.*, when it attacks a portion of intestine with a long mesentery, and not a fixed part such as the splenic or hepatic flexure.[*] These are the chief local points.

Amongst the general points that must weigh with the operator are the strength and nutrition of the patients, their fitness to bear a severe operation and to supply the needful plastic repair.

Another point having a most important bearing upon the advisability of performing resection for malignant disease is whether this is complicated by obstruction, tympanites, &c. If there is one point which published (and still more the unpublished*) cases prove, it is that the occasion in which it is right to submit a patient the subject of intestinal obstruction to such a prolonged operation as resection and suture or anastomosis of the resected parts must be of the very rarest.† This is plain from the usual state of the patient in these cases, and the conditions within the abdomen with which the operator has to deal. Is a patient, usually past middle life, whose strength and powers have been sapped for days or weeks by the nausea, inability to take food, vomiting, distension, and all the distress which forms part of a *miserere* of the later stages of chronic intestinal obstruction, in a fit state to go through a prolonged operation, and to supply after it the plastic repair which is needful for success? There can be but one answer here. And it is the same when we examine those local conditions which will have to be faced by the operator. The distension of the intestines, and the difficulty of keeping them within the belly, prolong the operation, add to the shock in an exhausted patient, and, by rendering asepsis most difficult, diminish his chances still further. Another point, viz., the condition of the intestine above and below the obstruction, is a strong argument against resection and union of the intestine when obstruction is present. Above, the intestine will be distended, congested, softened; below, empty and shrunken. The difference in the size of the two sections may prove a serious difficulty in their union, but a graver objection to uniting them now is the fact that for the present both are paralysed; and though this can be met, in a measure, by emptying the contents of the upper bowel when this is cut through above the growth, yet everyone familiar with these cases knows perfectly well that if the obstruction be low down it is extremely difficult to empty the bowel above sufficiently in the short time available. Much of its contents are left behind; the condition of obstruction largely continues, with its result—a continuance of toxic absorption; and if the contents of the intestine are passed on from above, too often they find the junction of the resected parts, made in softened, inflamed tissues, unfit to bear the strain. Where obstruction is present, resection should be deferred until one of following steps has been adopted. Colotomy may be performed in the cæcum or some part of the colon, to empty the intestine and restore its tone, while at the same time the patient's strength is restored, and the surgeon chooses his own time for the performance of what is a very severe operation. Another way of performing resection in two stages is that advocated by Mr. F. T. Paul,‡ whose name will frequently occur in these pages, as an authority in abdominal surgery. The following are the chief steps of this operation. 1. Explore first in the middle line unless the site of the obstruction is known. 2. Make a sufficiently free incision over the site of the obstruction. 3. Having cleared away any adhesions, tie the mesentery, and divide it sufficiently to free the bowel well beyond the growth on each side. 4. Let the loop of bowel containing the growth or stricture hang out of the abdomen, and sew together the mesentery and the adjacent sides of the two ends (Fig. 91). See that the stump of mesentery lies beneath the bowel, where, if deemed advisable, it can be drained by packing cyanide gauze down to it. 5. Ligature lightly a glass intestinal drainage-tube (Figs. 54 and 91) into the bowel above and below the obstruction, and then cut away the affected part. When the operation is thus performed, all the vessels except those in the primary incision are tied before they are cut, and the intra-peritonæal work is rendered bloodless. 6. The second stage of the operation—that of destroying the spur which, as will be gathered from Fig. 91, is formed by the above operation—is undertaken about three weeks later. A finger being introduced into the bowel, as a guide to each side of the spur, dressing-forceps with the handles fastened together by india-rubber tubing, or appropriate clamp-forceps, are applied to the spur, one blade on each side. These will come away within a week, and some days later the rest of the spur is destroyed in like fashion, the forceps being now applied as far as the finger makes out the spur to reach. As soon as this is satisfactorily accomplished the artificial anus is closed by separating the rosette of mucous membrane from the skin, turning it in, and bringing the freshened edge of the latter over it.

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[*] In the tables of Weir (*New York Med. Journ.*, Feb. 13, 1886); Butlin (*Oper. Surg. of Malig. Dis.*, p. 231), of the 37 cases collected in which resection of cancerous bowel was performed, 32 were of the large intestine. The parts involved were—cæcum, 7; ascending colon, 4; transverse colon, 3; descending colon, 7; sigmoid flexure, 9; "colon," 2. Malignant disease is so frequent in two regions, the ileo-cæcal and the left iliac fossa, that when there is any reason to suspect it an early exploratory incision should always be made.

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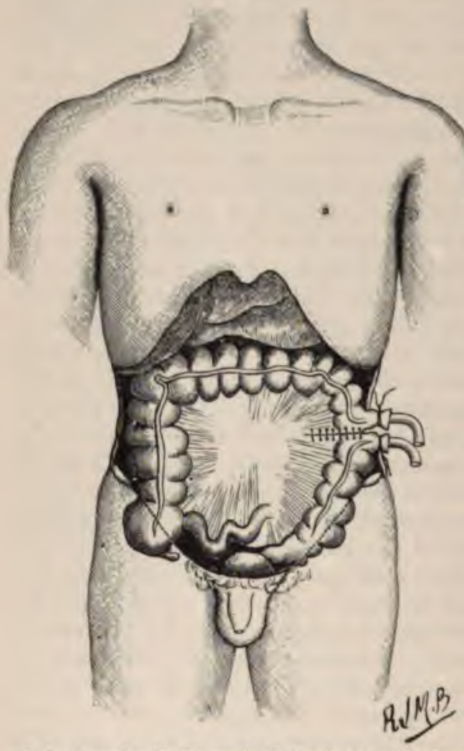
* Quite as instructive in their way. "Nec silet mors."

† Dr. Ricketts (*Ann. of Surg.*, vol. i. 1894, p. 472) relates a case which was most favourable for resection. The growth, only of the size of a hickory nut, was easily found, drawn out, and resected. The ends were united by a Murphy's button. The ileum being enormously distended with fæcal fluid, owing to the patient having deferred operation till the last, about a gallon was withdrawn by an incision, which was closed by Lembert's suture. The patient sank ten hours later.

‡ "Colectomy" (*Brit. Med. Journ.*, vol. i. 1895, p. 1136). A paper full of practical information, but especially noteworthy and admirable, nowadays, from its convincing candour. Failures are related as well as successes, and are equally instructive.

FIG. 91.

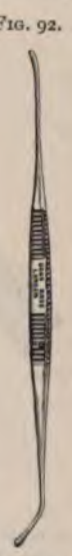


Colectomy by Paul's method. Drainage of the bowel, and preparation of it for subsequent safe resection of the bowel. (Paul.)

Another method is to get the affected coil outside; if this be not too tied down by adhesions, keep it so by means of a rod passed beneath it, a Paul's tube being then tied into the upper end to drain it. Some days later, when the patient's condition admits of it, the growth is resected, and the two ends united. Mr. Lane adopted this plan successfully in a very interesting case of growth of the lower part of the ileum. A knitting-needle covered with india-rubber tubing was employed here to keep the bowel outside (*Clin. Soc. Trans.*, vol. xxvi. p. 40).

Operation.—The first question which arises is as to the best **incision.** If the surgeon is uncertain as to the exact site of the growth, he may make a median incision and clear the matter up; otherwise the incision should be made over the growth itself, either horizontally, as in an incision for appendicitis or for left-sided inguinal colotomy, or vertically, or in one linea semilunaris. The variety of the incision is immaterial as long as the growth and the intestine entering and leaving it is thoroughly exposed. That the median incision is not best suited for this is shown by the number of cases recorded in which, after the operator had begun by an incision in the linea alba, he abandoned it, as inadequate, for one over the growth. The growth, when reached, may be covered by adherent omentum, or resemble an intussusception, appearing as a thick rounded, firm, sausage-like swelling. When the growth is fully exposed the surgeon settles whether to attempt resection or to perform a lateral anastomosis (p. 268). Resection being decided upon, the field of operation is carefully shut off from the general peritonæal sac by sterile gauze. I shall first describe a comparatively simple case—*e.g.*, resection of a limited growth of the small intestine or sigmoid, and, later, the more difficult removal of the ileo-cæcal coil. Any adhesions present must next be divided with a blunt-pointed scissors or a dissecting tool (Fig. 92). The difficulty met with here varies extremely. The adhesions may be so dense as to render further operation impossible. In such a case short-circuiting should be performed. Omental adhesions are not uncommon—*i.e.*, to the parietes, over the growth or adhesions between the omentum, and the small and large intestine contiguous to the growth. The loop having been freed is brought outside the wound, placed upon gauze, and emptied by gentle pressure with the fingers in both directions. This effected, clamps are applied well above and below the spots where it is decided to divide the intestine (*vide* p. 261). A host of such instruments have been devised. The best are those of Prof. Kocher (Fig. 93) and Mr. Makins (*St. Thomas's Hosp. Rep.*, 1884, p. 81) (Fig. 94). The former will be found extremely useful on account of the handles, by means of which the steps of the operation are greatly facilitated. Mr. Makins's have the advantage that the compression exercised can be more accurately adjusted by means of a screw.

FIG. 92.



Mr. Watson Cheyne's fine dissector. (Down's Catalogue, 1894.)

Several other clamps act by perforation of the mesentery. One of the simplest of these is the plan devised by the late Dr. Maunsell (*Amer. Journ. Med. Sci.*, March 1892).* A flat piece of sponge is placed over the bowel, about four or six inches from the part to be excised, and the sponge and the mesentery close to the gut are then transfixed with a strong safety-pin. The pin is again passed through the sponge on the other side of the gut and clamped. The sponge should be large enough to compress the intestine against the pin, so as to effectually prevent extravasation. The advantages claimed "are its extreme simplicity, its easy applicability, its innocuousness, and its efficiency." The pressure can be regulated by the size of the sponge. Another very simple method is that of Neuber, in which a narrow elastic band is passed through a small opening made in the mesentery, close to the intestine, and tied or clamped around the gut. Others have used cords of gauze. Fig. 95 shows a clamp devised on the same principle by Mr. W. A. Lane. In using any clamp which perforates the mesentery, great care must be taken not to injure any vessel. This is easily managed in the case of undistended intestine, but when obstruction is present and all the small vessels enlarged, very troublesome bleeding may follow perforation of the mesentery.

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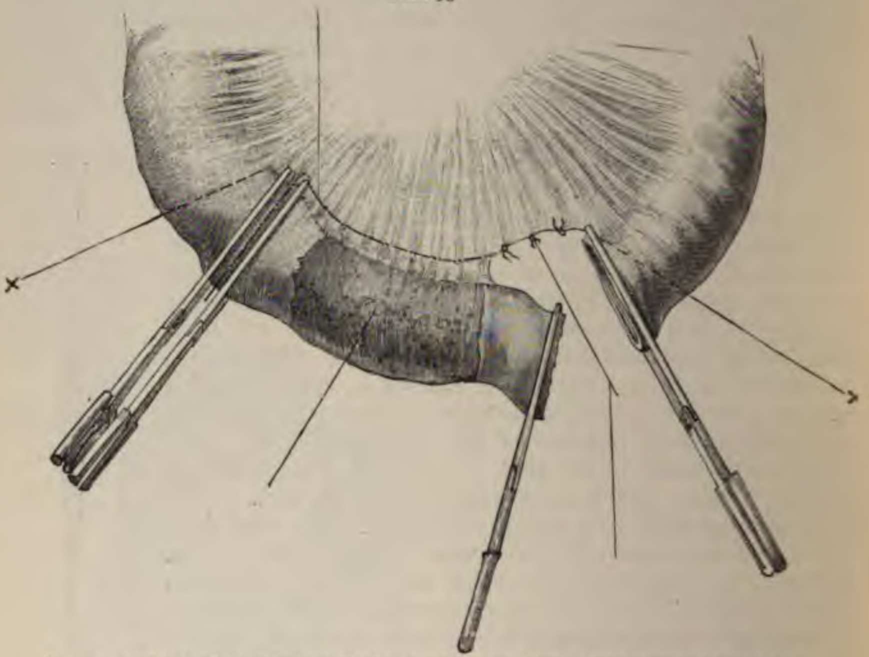
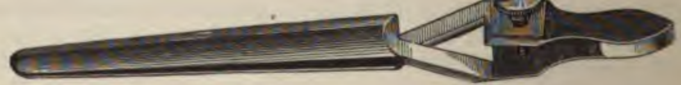
* The late Dr. Maunsell, writing of Neuber's method (*loc. supra cit.*), says: "I have tried this method and found that the bowel may be injured by the ligature, no matter what care may be taken in applying it."

FIG. 93



Resection of intestine, showing Kocher's clamps applied. The clamps should have been placed obliquely along the lines x x to ensure a good blood-supply. (Kocher.)

FIG. 94.



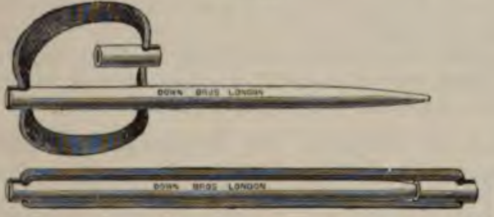
Mr. Makins's clamp-forceps, for use in resection of intestine. This and the next clamp should be covered with india-rubber.

Whatever form of clamp is used, if it has been long *in situ*, it may be well to shift it, and to cut away the ends of the intestine which have been submitted to pressure, for fear that their nutrition has suffered dangerously.

Where no clamps are obtainable an assistant's hands must be made use of. But clamps are much to be preferred; hands are more in the way, and, however willing, are liable to make more varying pressure, and to relax long before a tedious operation is completed.

If the intestine is at all distended,* it is emptied in the manner advised at footnote p. 265. The diseased mass is now resected with blunt-pointed scissors, the gut being cut across at right angles to its long axis quite three-quarters of an inch beyond the growth. This should leave about two inches of gut beyond each clamp, in order to allow of the introduction of a Murphy's button or a bobbin. As a rule, the section of the intestine should be made at right angles to its long axis, and, in the present instance, resection of intestine for growth, the incisions should be carried onwards through the mesentery so as to remove a triangular piece with the base below at the intestine. By this means it is possible that implicated lymphatics will be removed as well. The cut vessels in the mesentery are either clamped and tied with catgut, or, where a large piece has to be removed, they can be secured before, and hæmorrhage avoided, by means of an aneurysm-needle carrying catgut.

FIG. 95.



Lane's intestinal clamp. (Down's Catalogue, 1894.)

Another, but in the case of growth less desirable, way of treating the mesentery is given below (Figs. 97, 98). In either case any enlarged glands are now removed. The soiled gauze which has shut off the field of operation is next replaced by fresh, and the surgeon decides whether to unite the intestine by direct suture, by Murphy's button, or Robson's bobbin, or to perform anastomosis of the two parts of the intestine by Senn's plates, Murphy's button, or Robson's bobbin.

With regard to the details of the steps adopted in the more difficult operation of resection of the ileo-cæcal coil, I shall quote from a very helpful report of a case by Mr. Lowson, of Hull (*Lancet*, vol. i. 1893, p. 618):

> The abdomen having been opened by an incision in the right linea semilunaris, the omentum was found adherent to the tumour anteriorly, and detached after ligature. "Pushing the colon inwards," I now entered the scissors above the level of the tumour, through the peritonæum lining the posterior wall of the abdomen, to the outer side of

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* After emptying the intestine there may still remain much difference between the ends when resected. Either the upper segment must be partially closed by a continuous and Lembert's sutures until the part left patent corresponds to the lumen of the collapsed bowel below, a step successfully adopted by Sir F. Treves (*Lancet*, vol. i. 1893, p. 522), or both ends must be closed and a lateral anastomosis employed (p. 268).

the great bowel. and ran it down to a point opposite the lower end of the cæcum. The bowel could now be easily separated from its bed. It still remained to divide the peritonæum on the inner side where the colic vessels spread out, fan-like, to supply the colon. This was done by tying the serous membrane with the vessels in five or six successive pieces, and dividing between the ligatures and colon. The line of this incision inclined downwards and inwards, meeting the ileum as it crossed to join the colon five or six inches from the ileo-cæcal valve. Several diseased glands were included in this triangle. The ileum was separated from the mesentery in the same way, and now the greater part of the ascending colon, with the cæcum and four or five inches of the ileum, were free along with the tumour. The time had now arrived for dividing the bowel. Two long Makins's clamps were applied to the colon above the tumour, and between these the bowel was divided as nearly at right angles as possible. The ileum having been divided, and the diseased portions removed, the ends of the intestine were closed by fine continuous sutures and turned in by Lembert's sutures. Lateral anastomosis was performed by means of Senn's plates. Mr. Lowson draws attention to one detail, which, as he says, "cannot be neglected without fatal extravasation—*i.e.*, to be especially particular to bring the serous surfaces accurately in apposition at the point where the mesentery joins the intestine, and where the serous coat of the mesentery is deficient behind." The patient, aged 33, made a good recovery, and thirteen months later there was no perceptible recurrence.

(ii) **Resection of Intestine for Gangrenous Hernia.**[*]—This, the second most frequent indication for resection, must be treated separately. The operation has now to be undertaken under different conditions from that under which removal of a new growth is performed. We have seen (p. 257) that then it is always best to defer resection of the intestine, if possible, until obstruction has passed away under medical treatment, or has been met by a colotomy, the surgeon choosing his time when the patient's general condition of strength and nutrition, and the local state of the bowel, are alike rendered as favourable as may be for meeting the calls of a severe plastic operation. In resection for gangrenous hernia, the conditions both of the patient and the intestine to be operated on are very different. Before describing the actual operation I would say that no absolute rules can be laid down here. Relief of a strangulated hernia is one of those operations of emergency, sometimes admitting of no delay, which any general practitioner must undertake, often under very unfavourable surroundings. It would be most unfair to expect that such a man, when face to face with a gangrenous hernia, should meet it in the same way as a hospital surgeon, able to command the very best surroundings, abundant help, and himself experienced in intestinal surgery. As I have said at p. 40, when the condition of the patient, the experience of the operator, and his surroundings admit of his taking this step, resection of the gangrenous intestine should always be performed. Where the above conditions are absent, the operator must rest content with enlarging the wound,[†] drawing all the gangrenous intestine well outside the peritonæal sac, opening and draining it thoroughly by one of the means given at p. 178. This will avoid the terrible risks of a continuance of paralysis of the bowel, stercoraceous vomiting, exhaustion, or toxæmia. The loop must be kept outside by a sterilised bougie or glass rod, as in inguinal colotomy (p. 104), aided by a few sutures. Any gangrenous omentum must be removed, and the sac cleansed as far as possible.

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[*] The following are some of the most useful papers on this subject:—Lockwood (*Med.-Chir. Trans.*, vols. lxxiv. and lxxvii.); W. A. Lane (*Clin. Soc. Trans.*, vol .xxiv. p. 102); McCosh—three cases treated successfully by circular enterorraphy (*Ann. of Surg.*, vol. i. 1894, p. 647); Ransohoff (*ibid.*, vol. i. 1892); Mickulicz (*Berl. Klin. Woch.*, Nov. 10, 1892); Riedel (*Deut. Med. Woch.*, 1883, No. 45); Reichel (*Deut. Med. Woch.*, 1883, No. 45); Zeidler (*Cent. f. Chir.*, Jan. 16, 1893, p. 62); Caird (*Edin. Med. Journ.*, 1895, p. 312; Gibson (*Ann. of Surg.*, Oct. and Nov. 1900).

[†] In a very few cases, where the surroundings are even more unfavourable, the operator may have to be content with simply opening the bowel and doing no more (p. 40).

Operation.—The intestine being found to be gangrenous, the extent of this must be first made out. It is possible that in a few cases the mischief may be so circumscribed as to involve only part of the circumference of the bowel. Here the resection of a very small portion of bowel is required; while in some it may prove sufficient merely to invert and suture the margin of the aperture, and it is possible to accomplish this through the original wound. Successful cases of partial resection are recorded by Sachs (*Deut. Zeit. f. Chir.*, Bd. xxxii. S. 93); Barette (*Thèse de Paris*, 1883, "De l'Intervention Chirurgicale dans les Hernies"); Lindner (*Berl. Klin. Woch.*, 1891, p. 277). One or two cases have also been recorded in America, but such circumscribed mischief is very rarely met with, and, where such limited resection is practised, care must be taken to place the sutures in healthy tissues. Five cases of partial gangrene of the intestine treated by inversion of the gangrenous or ruptured portion are very briefly given in an instructive but very short paper by Mr. Caird (*Edin. Med. Journ.*, 1895, p. 312):

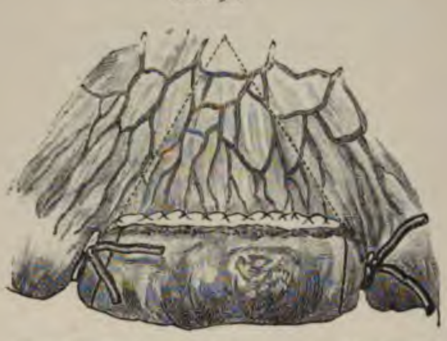
All five were cases of hernia. There was a "perforation" of the intestine in one, and a "rupture" in two. Of the five cases, three recovered. Of the two which died, one was an infant aged 18 months. The necropsy showed firm union of the intestine without peritonitis. "The intestine was beset with typhoid ulcers of ten or fourteen days' duration."

The following is Mr. Caird's advice as to the treatment of gangrenous intestine by inversion, and the cases suitable to this method: "If we meet with the typical elliptical necrosis of the bowel which runs longitudinally opposite the mesenteric attachment, we may, with Lembert's sutures, stitch the sound tissues over the unhealthy, thus inverting the gangrenous area into the lumen. This practice, which obviates the necessity of cutting any part of the bowel away, and requires no special dexterity, is in all probability not applicable with safety where more than one-third of the circumference is destroyed. The fear of stricture ensuing rather determines us to resect in such cases. . . . . The method of inversion, although easy, cannot be modified to meet the exigencies of every case. It does not lend itself to those instances in which the gut is almost completely divided by the tight grasp of a narrow femoral ring. The vitality of the proximal end has then been too severely tried to admit of such an experiment. We should require to invaginate a few inches of the damaged gut before we came upon healthy tissue to suture; and since it is impracticable to reproduce the successful natural cure occasionally seen in cases of intussusception, we are driven to resect." If inversion be made use of, the greatest care must be taken, as in partial or complete resection, to ensure that the sutures lie in healthy tissues.

Far commoner conditions are: (1) Where a whole loop or knuckle is gangrenous; (2) while the loop may appear fairly healthy at its neck (where the pressure has been exerted), one or two pressure-furrows or lines of ulceration are present, and the greatest care must be taken in drawing this part of the bowel down, or its contents may escape into the peritonæal sac. (3) The gangrene extends over the convexity of he loop. In these last three, free resection passing through healthy tissues will be required.

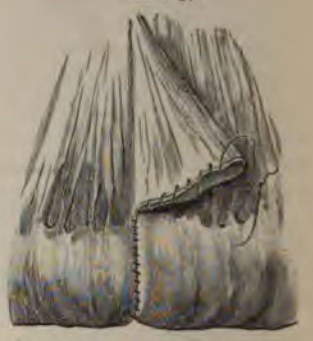
The first question that arises when resection is determined upon is whether we should carry it out through the original wound enlarged, or through a second in the linea alba. The answer to this must depend mainly upon the variety of the hernia and the means adopted for uniting the resected ends. Where union by suturing is adopted, or a contrivance of no great size is employed, the wound, especially in a femoral or umbilical hernia, will simply need enlarging freely. Where larger foreign bodies, such as Senn's plates, are employed, it may be wiser to make a fresh incision in the linea alba.* This will, of course, run the risk of contamination of the peritonæal sac, and call for every precaution for preventing it. Any gangrenous or septic omentum having been tied and removed, the sac and gangrenous intestine are carefully cleansed with perchloride lotion (1 in 5000), any opening in the bowel being temporarily but securely closed. An incision having been made below the umbilicus in the linea alba, the damaged loop is drawn out of the abdomen through this wound. Owing to the additional time taken by this fresh incision, the risk of contaminating the peritonæal sac, and the

FIG. 96.



Two different ways of dealing with the mesentery in resection of the intestine are here shown. In one the bowel is detached from the mesentery a little above their junction, all bleeding points being carefully tied, or the two folds of the mesentery united with a fine continuous suture. The dotted outline of the wedge shows the other mode of dealing with the mesentery. Drainage-tubes are used as clamps. (Esmarch and Kowalzig.)

FIG. 97.



Here the resected ends are shown sutured, and the edges of the redundant fold of mesentery which is present where no wedge is removed are being united with a continuous suture. Note that here and in Fig. 99 the union of the bowel and the mesentery is continuous across the triangular interval at the junction of the two. (Esmarch and Kowalzig.)

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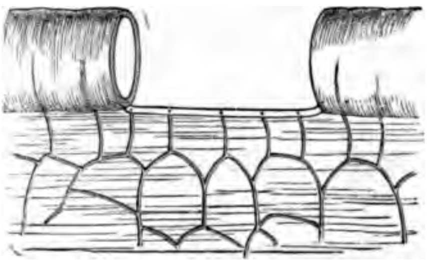
* Mr. W. A. Lane made use of this method in two cases in which he resected gangrenous hernia, and united the intestine by means of Senn's plates and lateral anastomosis (Fig. 110). One patient made a good recovery; the other, whose condition was very grave at the time of operation, died on the fifth day, and the necropsy showed a perforated gangrenous patch on the upper piece of the intestine (*Clin. Soc. Trans.*, vol. xxiv. p. 182).

fact that now, when the resected ends can be safely united by suture alone, or by a small body such as Murphy's button or Robson's bobbin, we can dispense with such large bodies as Senn's plates, it will be better to perform the resection through the original wound, which must be prolonged, if necessary, upwards in a femoral hernia, dividing Poupart's ligament, upwards or downwards in an umbilical, and upwards along the linea semilunaris in an inguinal hernia. The damaged loop having been drawn well out, the peritonæal sac is shut off with gauze, and clamps applied as advised at p. 259, care being taken to get well above the inflamed parts, and so to secure speedy and sound plastic union. The intestine to be sacrificed is now cut away, care being taken to remove too much rather than too little; for we find, in many of the fatal cases reported, that the cause of death was attributed to gangrene spreading upwards above the seat of suture; on the other hand, we find that recovery has followed when large portions of the intestine have been removed. Thus, Ramdohr excised 2 feet; Rydyggier had a case in which 54 centimetres were sacrificed; Rushton Parker cut out 12 inches; Walter also removed 2 feet 4 inches; and, lastly, Kocher had a patient who left the hospital perfectly well on the eighteenth day, after having had about 5½ feet of intestine removed. All these patients recovered (Kendal Franks, *Lancet*, vol. i. 1893, p. 1387). The rule must be, therefore, to remove every atom of suspicious bowel, and to cut through and place the sutures in healthy tissues.* It would seem from published cases that the mesentery may with equal success be treated as in Fig. 96, by excision of a wedge, or as in Figs. 97, 99. In this latter case the mesentery is divided as close to the bowel as possible. As, however, more time is occupied by the removal of a wedge, since many more vessels have to be tied, and as there is no corresponding advantage gained by so doing, the simpler plan of uniting the cut edges as in Figs. 97 and 99 is to be preferred.

FIG. 98.



A piece of intestine has been resected without removing any mesentery. (Mac Cormac.)

The ends having been resected, the intestine above emptied, cleansed, and the clamp above reapplied, the union of the resected ends is carried out by the particular method that has been decided upon (*vide* p. 227, *et seq.*). The clamps having been removed, the bowel, cleansed and dusted with iodoform, is returned; the upper part of the wound is next closed with deep sutures, the lowest of which should obliterate the neck of the sac. Poupart's ligament, if divided, must be united by buried sutures. As the sac will almost certainly have been septic, drainage should be employed.

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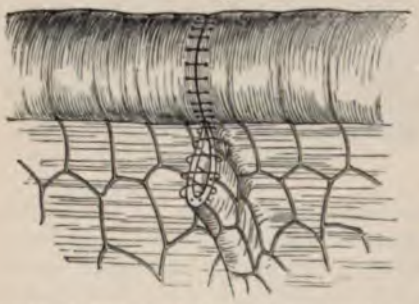
* Lockwood gives the useful hint to cut through the collapsed distal end first, as the gangrenous portion and the distended end may then be drawn further from the wound, and used as a spout to carry off the fæcal accumulation (*Med.-Chir. Trans.*, vol. lxxiv. p. 213). Caird (*Edin. Med. Journ.*, vol. ii. 1895, p. 314) advises thus on this point: The peritonæum being well shut off, "just beyond the *distal* end of the gangrenous mass a couple of long-bladed pressure-forceps should be applied side by side, and the gut completely divided between them. The mesentery should now be severed along its attachment to the portion of gut we wish to remove, and this enables us to hold the free extremity over a vessel, when, on removing the forceps, the contents escape and the congestion abates. Having thus relieved the congestion and emptied the gut, we may now reapply the forceps on the central healthy gut, and cut away the intervening damaged portion." Mr. Caird considers that if the pressure-forceps have inflicted any permanent damage on the cut margin of the gut that edge becomes inverted, thanks to the Lembert's sutures (*vide infra*).

The question of the advisability of attempting a radical cure now arises. Very often this will be forbidden by the general condition of the patient. Whenever there is any risk of septic infection, or any doubt as to the efficiency of the suture, the wound must be kept open. Mickulicz I understand him rightly (*loc. supra cit.*), leaves these cases open.

If any extravasation have taken place into the peritonæal sac, this must be cleansed, and drainage employed as advised at pp. 207, 217.

Fig. 99.

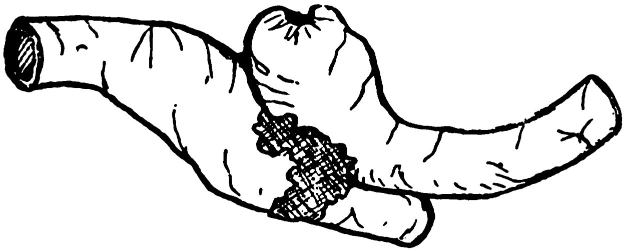


The intestine has been sutured, and the mesentery appears as a redundant fold whose edges have been united by a continuous suture. (Mac Cormac.) Sir William considered that this method of dealing with the mesentery would obviate to a large extent the risk of gangrene of the bowel.

It may be convenient to briefly recapitulate here the chief courses open in the treatment of gangrenous hernia. (1) Leaving things alone (p. 40); a course only to be adopted when the condition of the patient and the surroundings of the surgeon do not admit of more being done. (2) Primary resection either of a portion of a coil, as in a gunshot wound, or more usually of the whole loop. (3) Intermediate resection (Riedel, *Deut. Med. Woch.*, 1883, No. 45). Resection is performed, an artificial anus established, and after twenty-four or forty-eight hours the edges of the intestine are vivified and united by suture. (4) Enterostomy, or the making of an artificial anus and the closure of this at a subsequent date. In cases where the collapse of a patient demands prompt termination of the operation, the surgeon should insert two Paul's tubes in the ends of the intestine, keeping these well outside (Fig. 91). The spur and the artificial anus must be closed later on (p. 258). (5) If an unfavourable change take place in the patient's condition, before the surgeon has time to complete the suturing to his satisfaction, he may adopt Bouilly's mixed method (*Rev. de Chir.*, 1883). The ends of the intestine are sutured together by Lembert's method, with the exception of a small portion on the convex border, opposite its mesenteric attachment, where an opening is left. The edges of this are sutured to the abdominal wound, a fæcal fistula being thus formed, which Bouilly maintains will shortly close. In any case in which I was not satisfied as to the completeness and efficacy of the sutures, I should prefer to place the sutured bowel just within the abdomen, and pack it round with iodoform gauze to shut off the peritonæal sac until union is assured. In twenty-four or thirty-six hours it will be safe to remove the gauze and to close the wound by means of provisional sutures inserted at the time of the operation. Or the following precaution may be adopted.

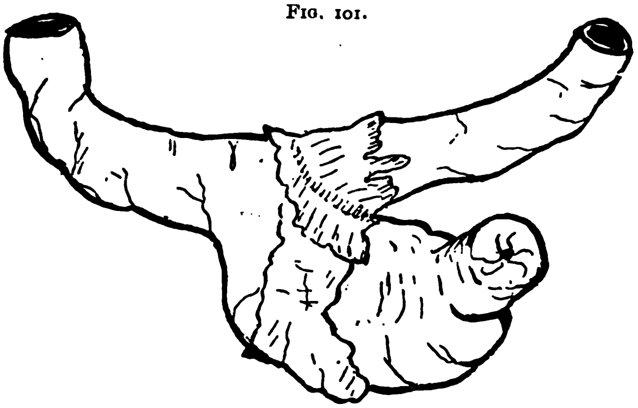
Omental Grafting (Figs. 100, 101, and 102).—This is one of those details in intestinal surgery which we owe to Senn. To strengthen a weak spot or line of union a strip of omentum is torn, not *cut*, from the free end of the omentum, laid over the spot which it is intended to strengthen, and secured with a few sutures. The contiguous surfaces may first be lightly scarified, short of causing bleeding. Another method, that of leaving the graft attached by one end, should not be adopted, as this may, later, bring about ill results in the form of intestinal obstruction.

FIG. 100.



Ileo-ileostomy, with Senn's plates, completed. An omental graft has been placed over the line of union. From a specimen removed from a dog some time after recovery. (Jessett.)

FIG. 101.



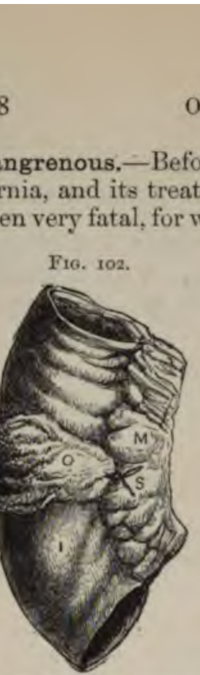
Ileo-colostomy. The line of implantation of the small into the large intestine has been covered with an omental graft. From a specimen removed from a dog some time after recovery. (Jessett.)

In the **after-treatment of resection cases** collapse must be vigorously combated, feeding by the bowel trusted to for thirty-six or forty-eight hours, and as little morphine or opium given as possible, for fear of "conducing to further, and perhaps fatal, intestinal paralysis" (Lockwood). Flatus will probably be passed in forty-eight hours, and the bowels act between the fourth and sixth days.

Treatment of Intestine which is Dangerous though not actually

Gangrenous.—Before leaving the subject of gangrenous intestine in hernia, and its treatment, there is one remaining allied class of hernia often very fatal, for which modern surgery may do much, viz., that in which the condition of the bowel is such that, though gangrene is not yet present, this may set in if the bowel be returned into the abdomen. In Ransohoff's words (*loc. supra cit.; Ann. of Surg.*, vol. ii. 1892, p. 349), "Such a knuckle is a menace. Bowel that is not at all doubtful in appearance will at times repay the trust placed in it by a perforation. Among ninety-six deaths after herniotomy it was, in twenty-six cases, the result of returning intestine which subsequently perforated. To return doubtful intestine is necessarily jeopardising life. To treat such intestine as radically as bowel already gangrenous is an extreme measure not to be advocated. Fortunately the intestine can be retained in the wound for a number of days in gauze packing or by sutures. When its viability has been established it is an easy matter to return it into the abdomen." Graefe has reported (*Deut. Zeit. f. Chir.*, Bd. xxxiv. S. 82) a successful case in which the intestine was so retained for five days before it was replaced.

FIG. 102.



An omental graft secured in place over the line of an enterorraphy. I, Intestine. M, Mesentery. O, Graft. S, Suture fixing graft. (Walsham.)

While I entirely agree with Dr. Ransohoff in the principle of the above, I think he represents the returning of such intestine as unduly easy. Even after twenty-four or thirty-six hours, the earliest date at which it will be safe to return it, the intestine will be found adherent to the gauze and to bleed easily.

INTESTINAL ANASTOMOSIS. SHORT-CIRCUITING. LATERAL ANASTOMOSIS.

The first two of the above-given terms have been often needlessly used for the same thing—viz., the establishment of a permanent fistulous opening between the bowel above and the bowel below some point of obstruction, usually a growth which cannot be removed.

By Lateral Anastomosis is meant the making of a fistulous opening between two parts of resected intestines, the two ends being first securely closed.

However end-to-end junction of resected intestine may ultimately be performed, it is certain that the above operations have a great future before them. The principle of them all, and the making them of practical utility, we owe to the labours and experiments of Prof. Senn.

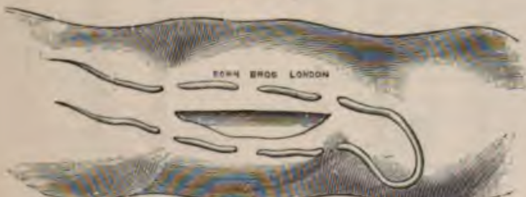
Indications.—Intestinal anastomosis or short-circuiting are to replace resection where the general and local conditions forbid the severer step in such cases as—(α) Growth; for cases suitable for resection see p. 256. (β) Contraction, cicatricial and not malignant in character. (γ) Matting of intestines by old mischief, perhaps dating to tubercular peritonitis, or inflammation about a caseous mesenteric gland. (δ) An intussusception which is irreducible but not gangrenous.

Advantages.—Prof. Senn claims the following, and with regard to the principle of intestinal anastomosis all will agree with him. As regards the details as to which method is the best, time alone will show. (1) That the operation can be rapidly performed with a great saving of time. (2) That the junction of the intestinal surfaces around the anastomosis is a safe one. (3) That the operation is independent of any difference in the size of the bowel above and below the obstruction. (4) That the principle is of very wide application. The objections are given at p. 249.

Operation.

I. Lateral Anastomosis with Murphy's Button (Fig. 103).—The technique here differs but little from that already given for end-to-end junction by this method. Similar spots in the ileum and cæcum having been chosen, a needle threaded with about a foot of silk is inserted in the long axis of the bowel as at Fig. 103; a stitch is taken through the entire wall of the bowel, one-third the length of the incision to be made; the needle is again inserted, one-third the length of the incision from its outlet, in a line with the first, and embracing the same amount of tissue. A loop, three inches long, is held here, and the needle is inserted in a similar manner, making two stitches parallel to the first in the reverse direction, and one-fourth of an inch from it, coming out at a point near the original insertion of the needle. This forms the running thread (Fig. 103) which, when tightened, draws the incised edge of the bowel within the cup of the button. A similar running thread is inserted in like fashion in the colon. Incisions two-thirds the length of the diameter of the button to be used are then made between the two running threads (Fig. 103), care being taken not to cut these, the female half of the button slipped into the ileum and the male into the colon, the running thread drawn tight and tied firmly round the central cylinders. While this is done, an assistant holds each half in place, and care is taken that the intestine is held evenly all round the cylinder in the grip of the ligature. The two halves of the button, next held in the fingers, are firmly pressed together until the serous surfaces are in accurate contact all round and at every point.

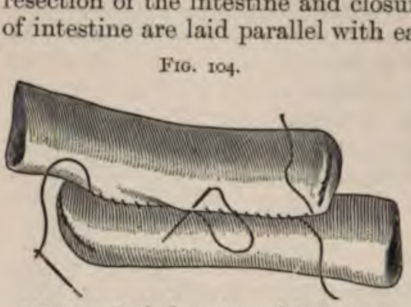
FIG. 103.



This shows the method of passing the puckering thread when Murphy's button is used in lateral intestinal anastomosis, gastro-enterostomy, &c.

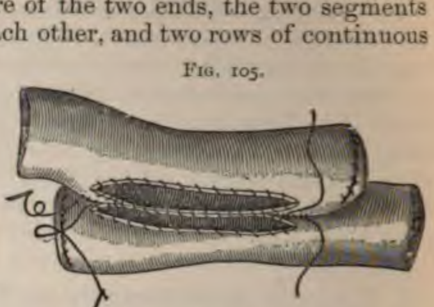
II. Lateral Anastomosis by Sutures alone (Figs. 104–108).—Some of the best American surgeons are abandoning artificial aids in anastomosis and preferring to trust to sutures alone, just as in end-to-end union they have returned to circular enterorraphy. The method of Abbe, which has given good results, is as follows: After resection of the intestine and closure of the two ends, the two segments of intestine are laid parallel with each other, and two rows of continuous

FIG. 104.



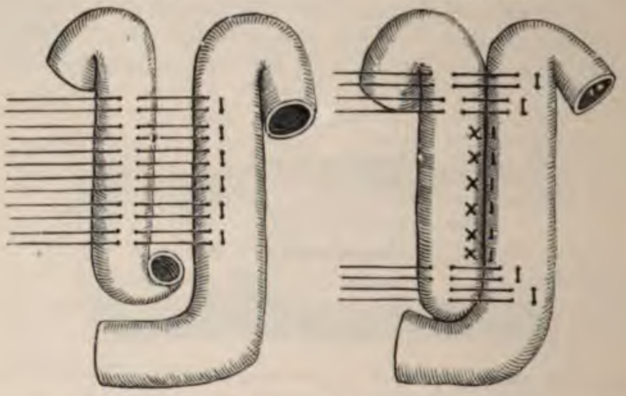
Abbe's method of anastomosis by sutures only. To show the suturing of the intestine before the incision is made. (*American Text-book of Surgery.*)

FIG. 105.



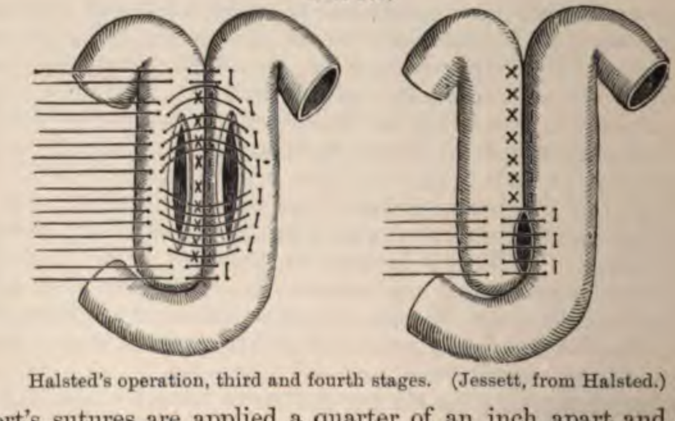
To show the four-inch openings and the sewing of the edges. (*American Text-book of Surgery.*)

FIG. 106. FIG. 107.



Method of lateral anastomosis by Halsted's simple suturing. The sutures are of the square kind. Fig. 106, first stage; Fig. 107, second stage. (Jessett, from Halsted.)

FIG. 108.

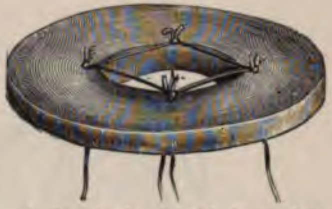


Halsted's operation, third and fourth stages. (Jessett, from Halsted.)

Lembert's sutures are applied a quarter of an inch apart and an inch longer than the incision which it is proposed to make (Fig. 104). Each piece of silk (twenty-four inches long) is left at the end of its row, being still threaded. The bowel is then opened for four inches, a quarter of an inch from the sutures, both rows being to one side of the cut. Any vessels that bleed are treated by forci-pressure. The opposite segment of bowel is then opened in the same way. The two adjacent cut edges are now united by a suture which traverses both the mucous and serous wall (Fig. 105), and so secures any bleeding points, the forceps being taken off as they are reached. The two free cut edges are secured with a similar "whipping" stitch, after which the serous surfaces on the opposite side of the opening are approximated and secured by continuous Lembert's sutures, the first threads securing this purpose. It is claimed that this method requires little, if any, longer time than that with plates or rings of any kind, and that it is free from many of their disadvantages, viz., the need of special apparatus, foreign bodies which have to come away, contraction of the opening, which is here so very free, and the collapse of the mucous membrane through the opening.

Dr. Halsted has described another method of intestinal anastomosis by suture only (*Bulletins Johns Hopkins Hospital*, vol. ii. No. 10). He prefers quilt or square sutures (Figs. 106 to 108) because one row is sufficient, and they tear out less easily and constrict the tissues less than do the Lembert's sutures. The following are the steps of this method. The two selected portions of intestine having been placed in contact along their mesenteric borders, six square sutures are put in a straight row, tied, and cut short. At each end of this, the posterior row of sutures, and nearer the free border, two lateral square sutures, are applied (Fig. 107), tied, and cut short. Eight or nine square sutures are now applied so as to draw together the free borders. These sutures are not, however, tied, but drawn aside (Fig. 108), so as to make room for the scissors with which the two segments of intestine are opened. Finally, the sutures of the anterior row are tied and cut short.

FIG. 109.



A Senn's decalcified bone-plate ready for use. When the first threads have been passed they should be secured to the back of the plate and to each other by another thread passing between each as in the figure. The plates should be kept in a solution of equal parts of alcohol, glycerine, and water, being placed in 1—40 carbolic acid lotion before use. They are on no account to be inserted dry, owing to the certainty of their swelling and causing tension, sloughing, &c. (Walsham.)

III. **With Senn's Plates.***—These were substituted for sutures by their ingenious author with the object of (*a*) saving time, (*b*) doing away with the evils of numerous sutures, (*c*) of securing a wider approximation of serous surfaces, and a more complete rest for the parts to be united. The decalcified bone plates, each with the four sutures, two above and below at the ends, and two at the sides, are well known (Fig. 109).

If the plates are not threaded this can be quickly done by passing two round needles, carrying about twenty-four inches of silk, from before backwards through one end perforation, and then from behind forwards through one lateral perforation. The needles are cut away and the four ends knotted (Fig. 109).

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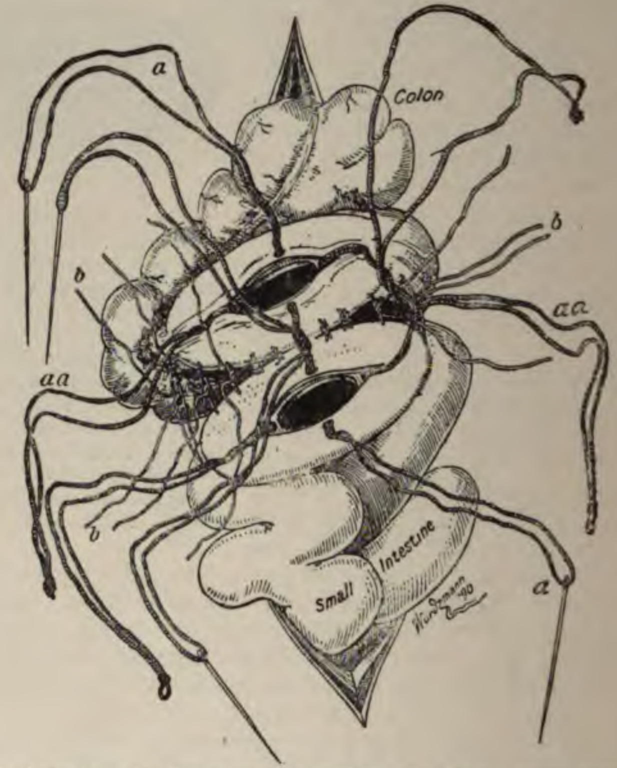
hough to some this method may appear out of date, it is retained here in o the brilliant ingenuity of its inventor.

As an instance of this operation we will take ileo-colostomy or anastomosis of the ileum and ascending colon, when a carcinoma of the cæcum—a common instance of malignant disease of the intestine—is found not to admit of removal. An incision having been made over the mass, horizontally or vertically, or in the right linea semilunaris, as advised at p. 259, a suitable piece of the ileum and the ascending colon* are, if possible, brought into the wound. If this cannot be effected the pieces of bowel chosen and the area of operation must be carefully packed off with iodoform gauze or sponges.† The parts which are to be joined

FIG. 110.



Intestinal anastomosis—ileo-colostomy—with Senn's plates. These have not yet been approximated. The cæcum here has not been resected. Cf. with Fig. 113. *a*, *a*, Lateral transfixion or fixation sutures passed through the intestine. *aa*, *aa*, End or apposition sutures hanging out of the wound. *b*, *b*, Posterior or row of Lembert's sutures. (Jessett, from Senn.)

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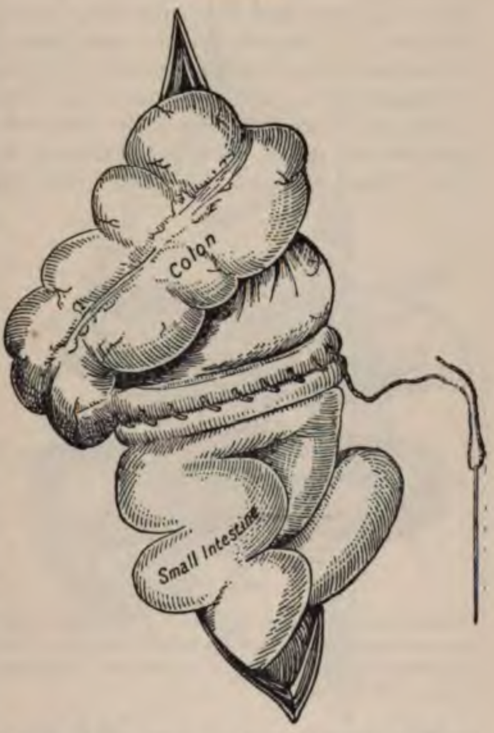
* In Sir F. Treves's words (*Oper. Surg.*, vol. ii. p. 340), these two parts of bowel "should not be so far distant from one another as to exclude a large tract of intestine after the operation is complete, nor so near as to expose the actual area of disease, or to render the manipulation of the parts difficult. It is probable that the upper coil will be distended and hypertrophied, and the lower empty and wasted."

† I prefer both in a case of this kind: flat sponges (held by Spencer Wells's forceps) pushed well into the abdomen to keep the small intestine, &c., back; and over these, tampons of iodoform gauze lining the edges of the wound.

by anastomosis having been brought outside, they are laid on aseptic gauze, gently emptied with the fingers, and kept so with clamps of some kind (p. 259). If the upper end be much distended the opening for the plate is made at once. An incision about an inch and a half long[*] is made in the long axis of the ileum on its free border, and the contents allowed to escape where they can do no harm. Any free bleeding from the incision will yield to forci-pressure without ligature. If there be plenty of time it will be well, as advised by Mr. Jessett, to run a continuous suture around each opening (Fig. 105); this will arrest any bleeding, and prevent the closure of the wound and prolapse of the mucous membrane. The lumen of the opened intestine, as far as it can be reached, having been cleansed with pledgets of aseptic wool, a bone plate (Fig. 109), threaded, is inserted edgeways, and when it is completely within the lumen of the bowel, traction is so made on the sutures as to bring the plate with its threaded surface upwards in the wound, and with its central opening accurately placed with reference to the opening in the intestine (Fig. 110).

FIG. 111.



Intestinal anastomosis—ileo-colostomy—with Senn's plates. These are now approximated and the anterior row of sutures is being applied. The cæcum here has not been resected. Cf. with Fig. 113. (Jessett, after Senn.)

The plate is then fixed in this position by transfixing the wall of the bowel near the edges of the opening, and at spots equidistant from its angles with the lateral sutures (*a*, *a*, Fig. 110). The end sutures hang out of the upper and lower angles of the wound (*aa*, *aa*, Fig. 110). A longitudinal incision is next made in the colon, opposite to the meso-colon, well above the disease, and a bone plate introduced here with precautions similar to those already given.

The peritonæum covering each plate is now lightly scarified with numerous cross lines made by a needle, but not deep enough to cause bleeding, and the serous coats where these are in contact along the posterior margins of the plates are united with a few superficial sutures (Fig. 110).

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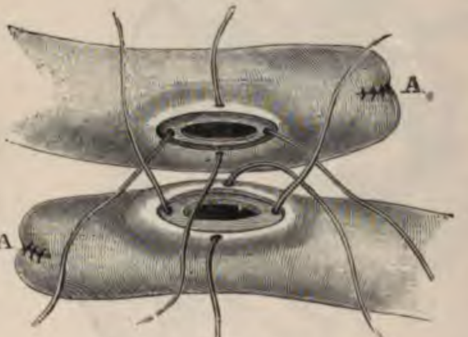
[*] If the opening be too small, force will have to be employed in inserting the plate, and bruising will follow; if too large, the plates may escape or ride loosely after the sutures have been tied.

The plates being how held in accurate apposition by an assistant, the threads which have previously been identified are tied in the following order: first, the inner lateral sutures (these are shown in process of tying, Fig. 110); next the pair of end threads which are farthest from the operator are tied, and then the opposite pair. In tying these, the threads must be drawn down between the plates. Finally the only remaining or the outer lateral threads are tied. In tying each of the four pairs, sufficient force only must be used to bring and keep the plates together, and to ensure firm knots. All that now remains is to reinforce the threads which have been tied by running together the serous surfaces along the anterior margins of the plates by a few points of sutures, or a continuous one (Fig. 111).

The parts are now carefully cleansed, the clamps taken off, the flat sponges and gauze tampons removed, and the peritonæal sac cleansed of any blood clot, &c. A little iodoform is now rubbed along the lines of sutures in the intestines operated on, and the parts returned. The wound is then closed in the usual way.

FIG. 112.

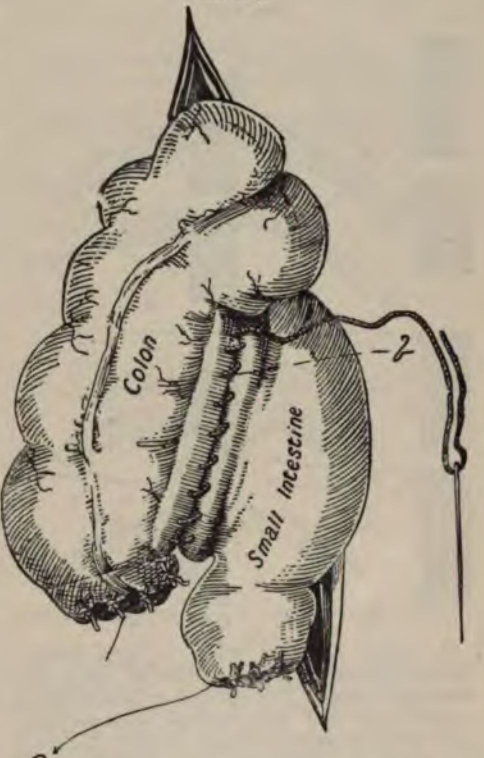


Intestinal anastomosis by Senn's plates after complete resection of a part of the small intestine. The ends have been closed by a continuous Lembert's suture. (Walsham.)

Anastomosis with Senn's plates after excision of the cæcum.—Intestinal anastomosis, *e.g.*, ileo-colostomy in cases where removal of the ileo-cæcal coil was impossible, having been described, we shall next imagine a case where it has been possible to remove the bowel, but the surgeon prefers to unite the ends by lateral anastomosis instead of end-to-end union. The account is Prof. Senn's (*Journ. Amer. Med. Assoc.*, June 14, 1890): "After all hæmorrhage had been carefully arrested both resected ends were closed by invagination and a few stitches of the continuous suture (*a*, Fig. 113). The first stitch was made to transfix the mesentery at the point where it was invaginated into the bowel. Medium-sized perforated decalcified bone plates were used in making the ileo-colostomy by lateral approximation. An incision about two inches in length was made in the closed ends of both intestines at a point opposite the mesenteric attachment, and into each opening a bone plate was inserted, and the lateral sutures, armed with a needle, were passed about an eighth of an inch from the margin of the wound at a point half-way between the angles of the intestinal wound. The margins of the bowel corresponding to the parts covering the plates were freely scarified with an ordinary sewing needle. The visceral wounds were now brought *vis-à-vis* in such a manner that both closed ends were directed downwards, bringing in this manner the free surface of the colon and ileum together.

Before any of the plate-sutures were tied, a number of Lembert sutures were applied posteriorly, sufficiently far back so that after the approximation they should be just beyond the borders of the plates, thus affording sufficient security in maintaining co-aptation. The posterior pair of transfixion sutures* were now tied, after which both pairs of the sutures not armed with needles were tied. During the tying of these sutures, it is of the greatest importance that an assistant should keep the plates accurately and closely pressed together. The last sutures to be tied were the second pair of fixation sutures; and as this was being done, the bowel on each side was carefully pushed in between the plates with a probe. The sutures were tied in a square knot, and only with sufficient firmness to bring the parts in apposition, as any undue pressure would have been detrimental, and might have resulted in gangrene of the tissues included between the plates. The sutures were cut short, and the ends brought as near the opening as possible, by pushing them in this direction with a probe. After all the approximation sutures were tied, it only remained to apply in the upper side a few Lembert sutures or a continuous one (*b*, Fig. 113) in the same manner as was done on the opposite side before any of the approximation sutures were tied."

FIG. 113.



Intestinal anastomosis—ileo-colostomy with Senn's plates. The cæcum here has been resected. Cf. with Figs 110 and 111. *a*, Closed ends of ileum and colon. *b*, A continuous suture uniting the serous surfaces over the anterior margins of the plates. (Jessett, after Senn.)

Mr. Littlewood, of Leeds, has suggested (*Lancet*, vol. i. 1892, p. 866) **a modification of Senn's plates,** with the object of (1) doing away with the sutures, some of which perforate the whole thickness of the bowel, and thus may introduce sepsis; (2) of performing the operation more quickly; (3) of ensuring a good opening between the two viscera. The suggested modification is that by means of a decalcified bone tube fixed in its opening, one plate fits accurately into the aperture of the other. By this means it is thought that the two plates would be held together, while the two visceral walls between them would be brought evenly in contact with each other.

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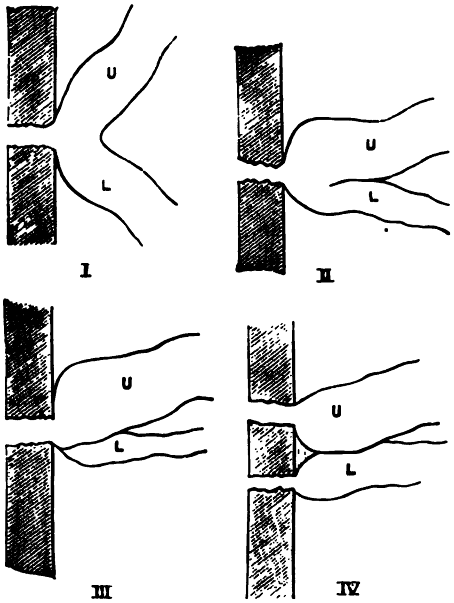
* The two seen tied between the two plates in Fig. 110.

CLOSURE OF FÆCAL FISTULA OR ARTIFICIAL ANUS.

Fig. 114 shows, diagrammatically, some of the chief points of difference between a fæcal fistula and an artificial anus. Before operating, certain points of much practical importance should be considered, and first how far any spur or septum is developed. The more marked this is, the less is the chance of closing the opening by any slight plastic operation such as paring and suturing the edges of the opening. The spur being left behind, the fæces will make their way through the sutures, and the longer this condition is allowed to remain, the more, of necessity, will the lower segment of intestine atrophy, and the more marked will be the difference between the two parts of the bowel. Other important points are the nutrition of the patient and the condition of the area surrounding the wound. The higher the fistula is situated in the small intestine the more will the nutrition have suffered, and the more profuse and liquid is the discharge the wider and the more infiltrated will be the eczematous area around.

Fig. 114.



U, Upper. L, Lower bowel. I, Fæcal fistula. The gut is not bent very acutely on itself, and there is no spur. The opening in the bowel is usually small and communicates with the skin generally by a sinus-like track. II., III., Artificial anus. The bowel is here more acutely bent and a spur is present. In an artificial anus the opening communicates more directly with the surface than is here shown. IV., Double fæcal fistula. (Greig Smith.)

Previous Treatment.—We will suppose that the pressure of a truss, the cautery, the destruction of the spur,* and the use of india-rubber tubing, have each been tried in suitable cases.

Sir W. M. Banks (*Clin. Notes*, p. 94) describes the following simple and ingenious method. Where the septum or spur is not well developed, it may be expected to succeed In an artificial anus in the groin, after a femoral hernia, he introduced a thick piece of india-rubber tubing, pushing one end up the ascending and the other down the descending bowel. It was secured by silk brought out of the opening. It was calculated that the pressure of the tubing against the projecting spur would press it back, and allow the fæces to pass round the corner without passing out of the artificial anus. At the end of seven weeks nearly all the fæces passed by the rectum instead of by the artificial anus, this being reduced to a sinus, giving vent to a few drops of yellowish fluid. At the end of three months this completely closed.

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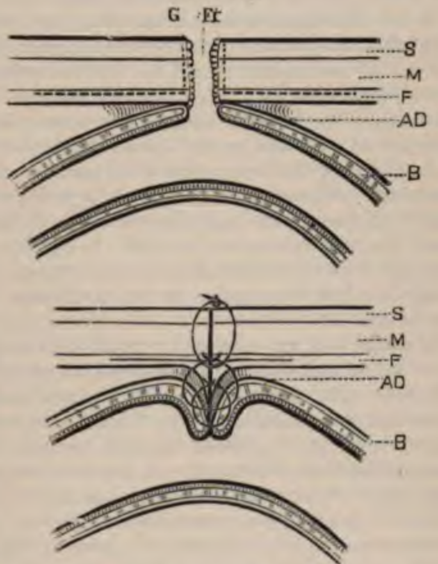
* This may be effected by the use of pressure-forceps, as suggested by Mr. Paul. Their use is given at p. 258.

Operation.

Three methods will be mentioned. i. Here **the peritonæal sac is not opened.** The margins of the fistula having been sufficiently freed, they are pared and brought together with silk sutures and kept apposed. Hare-lip pins may assist in taking off the tension. This method can only be suitable to small fæcal fistulæ where the exposure of mucous membrane is trifling and no spur is present. It usually fails from the separation of the edges of the fistula not being free enough, owing to the operator's fear of opening the peritonæal sac, thus causing tension on the sutures.

Fig. 115.



Diagrams to show Greig Smith's method of closing fæcal fistula.

Fi, Fistula in abdominal wall communicating with the bowel. G, Granulations lining the fæcal fistula. S, Skin. M, Muscular layer. F, Subperitonæal tissue. AD, Adhesions between bowel and peritonæum surrounding the fistula. B, Bowel.

The *broken line* in the upper diagram shows the incisions around the fistula and in the sub-peritonæal areolar tissue. The lower diagram shows the operation completed and the sutures placed. (Greig Smith.)

The late Mr. Greig Smith (*Abdom. Surg.*, p. 728) spoke highly of the following operation, which may be used both for cases of fæcal fistula and artificial anus. In applying the method, however, to cases of artificial anus, the spur must be first diminished and the lower part of the bowel dilated to some extent. In order to accomplish this, Mr. Greig Smith advises the introduction of an india-rubber tube, after Banks' plan, for some days before the operation is performed.

Any granulations having been scraped away and the aperture in the bowel plugged by a sponge, two incisions are made, one above and one below the fistula, and joined by curved incisions which include the fistula. The extra-peritonæal fatty tissue having been reached, the parietal peritonæum is separated from the abdominal wall all round the fistula for at least two inches. This step will be best carried out by commencing the separation at the extremities of the incisions which are most remote from the fistula, and working towards the latter. The bowel with the loosened peritonæum can now be lifted out through the incision in the parietes. If there is any difficulty in doing this, a little more detachment of peritonæum will make it easy. The fistulous track is now cut away down to the level of the bowel, and the opening in the latter closed by one or more rows of Lembert's sutures inverting the rawed edges (Fig. 115). The intestine and peritonæum are now replaced and the parietal incision closed, with the exception of a small opening, through which a drain is passed down to the sutured gut.

ii. and iii. Here **the peritonæal sac is opened.**

ii. **Closure of the opening without complete resection of the bowel.**—The preliminary steps as to diet and treatment of the eczematous skin given below (p. 279) should be carefully attended to. The following account is taken from the report of a patient under my care in Guy's Hospital in August 1895:—

At an operation for acute intestinal obstruction due to bands, a gangrenous patch had been found in the ileum, and the intestine had been drained through a Paul's glass tube. This the patient pulled out, and an artificial anus resulted. The gut was plugged with small sponges tied on silk and pushed about two inches above and below the opening. Two curved incisions were then made so as to include an oval three inches and a half long and an inch and a half wide. In the centre of this lay the opening surrounded by the usual eczematous margin, most of which was enclosed by the above incisions. The incisions passed through the rectus on each side. After the posterior layers of the sheath had been reached the incisions were very cautiously deepened until the peritonæum was reached. In opening this an exploring finger was introduced through each lateral cut so as to make certain that no coils of intestine were adherent beneath. The finger being used as a director, the peritonæum was cut through along the lateral incisions in their whole extent. An oval island of the tissues forming the abdominal wall was now set free and could be drawn forward with the bowel adherent to it below, and showing the sponges which had been introduced as plugs bulging out its coats. The bowel in which lay the artificial anus was now separated from adjacent coils and the adhesions which bound it to the parietes, partly with a steel director, partly with blunt-pointed scissors, used at one time closed and at another open. Sponges and iodoform tampons had previously been packed around so as to soak up any blood. When the artificial anus had been separated from all adhesions it was found to be about two inches and a half long. Its edges were pared, and the plugging sponges having been removed, the opening was closed with a double silk suture—first a continuous one taking up all the coats, and then a row of Lembert's securing sufficient inversion. These were carried well beyond the actual limits of the opening (Fig. 55, p. 228). A little iodoform having been rubbed in along the line of suture, the intestine was returned. A few tags of omentum which were adherent to the abdominal wall in the vicinity of the wound were detached and tied. When the intestine was returned the interior of the abdomen was quite free from all blood or other discharges. The edges of the wound were then brought together as far as possible, but this was only feasible above and below. In the centre was a lozenge-shaped gap, measuring two inches and a half long by an inch wide, at the bottom of which lay the sutured intestine. The gap was lightly plugged with iodoform gauze wrung out of carbolic acid lotion (1 in 20). The patient made a good recovery, the only drawback being his weak condition, due to his having been fed so long (seventy-two hours, including the time before and after the operation) by enemata. Flatus was passed on the second day, and the bowels acted well two days later. A fortnight after the operation I placed numerous large grafts, cut from the shoulders by Thiersch's method, on the granulating surface which represented the remains of the oval gap in the parietes. All was soundly healed within five weeks of the operation. I lost sight of the patient for five months, when he returned with a ventral hernia. This he attributed to his having had scarlet fever, and to the pad of the belt with which he had been supplied having shrunk after the baking to which it and his clothing had been submitted. He was otherwise in excellent health, without any flatulence or constipation, enjoying his food and able to go about helping his father, who is a costermonger. He was supplied with a new pad. If the hernia increase, it will, I think, be now possible to pare the edges of the old oval gap, and to bring them together, a step quite impossible at the time of the operation.

iii. Closure of the Artificial Anus with complete resection of the bowel.—If this step be needed I know of no clearer account than that of Mr. Makins (*St. Thomas's Hosp. Rep.*, vol. xiii. p. 18). The skill with which the operation was carried out was only equalled by the thoughtfulness with which it was planned.

The patient was 21. The artificial anus, dating to a hernia, was high up in the small intestine, and opened about an inch and a half above the centre of Poupart's ligament. Here, at the bottom of a small pit, the mucous membrane of the intestine was slightly prolapsed. The gut was firmly attached: the finger only passed into the upper opening; the lower could not be found. First, the usual eczematous condition was very much improved by the use of a small shield, and mopping away of discharge with absorbent wool. No food was given by the mouth after the evening of the second day before the operation, nutrient enemata being given every four hours. During the day before, the upper end of the bowel was washed out with injections of salicylic lotion. As bile-stained fluid was escaping from the fistula an hour before the operation, this washing out was repeated. Before beginning the operation a bit of carbolised sponge attached to string was passed for two inches into the upper end of the bowel. A vertical incision of two inches and a half being made through the abdominal wall, the upper end of the intestine, normal in size, was dissected free from its adhesions; the lower end, lying just below it, was contracted to the size of a pencil, with an opening only large enough to admit a director.*

The two ends of the gut being now provisionally clamped with forceps (Fig. 94), sheathed in tubing, they were drawn out, and a number of sponges attached to string packed round them. The sponge was then drawn from the upper end of the intestine, and about an inch removed from the upper end and two inches and a half from the lower one, together with a wedge of mesentery four inches long by three-quarters of an inch wide. The cut surfaces then nearly corresponded. The bleeding points having been tied in the mesentery, this was united with six silk sutures, and the gut then sutured as follows:—A first row of twenty-five very fine Chinese-twist stitches were passed with a small curved needle through the whole thickness of the gut, about one-tenth of an inch from its free margin, commencing at the mesenteric border. These were tied in batches of five at a time. Then a second row of Lembert's sutures (Figs. 55 and 58) were passed and tied in the same manner. During the stitching, which took about three-quarters of an hour, the gut was kept moist with warm salicylic lotion. After the bowel was closed and returned, it was found impossible to close the whole wound. As this could only be brought together above and below, the granulations were shaved away and the intestine left at the bottom of a deep pit. Iodoform-gauze and pine-wood dressings were applied. The patient made a good recovery. Two days later the intestine could be seen at the bottom of the wound covered with lymph and showing vermicular movements. The bowels acted naturally two days after the operation. No fæces came by the wound, but twelve sutures were thus discharged.

ENTEROPLASTY.

This term has been given to an operation for the relief (short of resection) of strictures of the intestine believed to be innocent. It is based upon a similar operation performed several times successfully upon a pylorus, the seat of contraction not due to malignant disease, and called Pyloroplasty (Fig. 123, p. 313). As far as I know, Mr. H. W. Allingham's two cases (*Lancet*, vol. i. 1894, p. 1550) are the only ones yet published. One such stricture occurred in a woman, aged 48, at the junction of the ileum and jejunum, the other in the sigmoid of a patient aged 73. It is simply stated that "the stricture was innocent," and "not malignant." As the cases were published within two months of the operation, the nature of the stricture must remain very doubtful. The age of the patients, the position of one in the sigmoid, and absence of any history of dysentery, are very suspicious. In each case the stricture was divided in the following way: The bowel having been drawn out, shut off with sponges, and clamps applied above and below, the bowel and stricture were divided longitudinally for three inches, on the side of the gut opposite to the mesenteric attachment. Each lip of the longitudinal incision was then caught hold of at about its centre, pulled apart so that at first it gave the appearance of a diamond-shaped opening, and then, by further pulling in the same direction, the original longitudinal incision was made into one transverse to the long axis of the bowel. The opening was then closed, first with a continuous suture uniting the mucous membrane, and then by Lembert's interrupted sutures.

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* Over two months had elapsed since the formation of the fistula, and one month since the last proper action of the bowels.

CHAPTER VI.

OPERATIVE INTERFERENCE IN GUNSHOT AND OTHER INJURIES OF THE ABDOMEN. RUPTURE OF THE INTESTINE.

GUNSHOT AND OTHER INJURIES.

WE owe the great advances lately made here, in the first place, to antiseptic surgery, and, in the second, to the zeal with which American* surgeons have taken up the matter and made known their results, unsuccessful as well as successful.

1. *Examination of the Wound, with regard to Penetration.*—Blackening of the wound and the clothes with powder suggests a close shot and probable penetration. Edges clean cut and equally stained show that the bullet has struck perpendicularly. Unequal staining and raggedness suggest obliquity of impact; and the less perpendicular this is, the less the probability of penetration. If there exists a continuous track of tenderness, especially if accompanied with slight redness, from the wound for some distance over the abdominal surface, it is fair to infer that the missile has wormed itself between the layers, without penetration (Parkes).

2. *Symptoms indicating Penetration.*

(*a*) Circumscribed dulness and bulging near the wound, fluctuation in the peritonæal sac, or either of the last two felt per rectum or vaginam, indicate wound of a large vessel and accumulation of blood, and penetration, with visceral injury, probably; but, to be diagnostic, it must come on within a couple of hours. (*β*) Rapidly-forming† tympanites indicates penetration and escape of gas from the intestine. (*γ*) Escape of fæces, bile, or urine from the wound is, of course, diagnostic of penetration, but rare. (*δ*) Repeated hæmatemesis indicates penetration and injury to the stomach or small intestine high up. It may, however, be due to contusion. (*ε*) Profuse hæmorrhage per anum points to penetration and injury of intestine, but is seldom seen sufficiently early to be of value. (*ζ*) Hæmaturia indicates injury of some part of the urinary tract. (η) Escape of blood from the wound, if too profuse to be accounted for by a wound of a vessel in the abdominal wall, points to penetration and visceral injury. (θ) Paralysis of any part below the level of the wound is a most grave complication, indicating, as it does, injury to cord or nerves, as well as, probably, to viscera. (ι) Shock. This does not go for much unless hæmorrhage is clearly present also, owing to the great difference in individual peculiarities.

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* In addition to the American writers I have quoted below, I have had the advantage of reading a very careful study of this subject by my old dresser, Dr. J. H. Barnard, now of Paris, *Des Plaies de l'Intestine par Armes-à-feu* (Thèse pour le Doctorat en Médecine, Paris, 1887).

† If delayed, the tympanites may be due to paralysis of the intestines from shock.

Other points will be, the size of the bullet and the amount of fulminative or powder, the distance and direction in which the firearm was held. A single opening gives, *per se*, a faint hope that there is no penetration.

In cases of doubt as to penetration, the wound will be first enlarged, then explored with a probe or bougie, and the line of damage to the tissues carefully followed up, any exploring instruments being kept strictly aseptic.

3. *Probable Amount of Damage.*—Dr. Parkes (*Ann. of Surg.*, Nov. 1887) gives the following suggestions:—"An antero-posterior shot below the level of the umbilicus and well towards the lateral surfaces of the body will be very likely to miss the small intestines entirely, and expend its damage on the large bowel. The same kind of wound high in the lateral surfaces may pass into or through the liver without injuring the intestines, or the spleen alone if the entrance is on the left side.

"If the wound is so situated that the bullet enters the abdomen through the diaphragm, adding injury of abdominal viscera to that of the contents of the chest, the surgeon's help will probably be of little use. A wound of entrance and exit, or an entrance wound alone, showing passage of the ball from side to side through the abdomen, means the worst of injuries, and suggests the need of the greatest care in staying of hæmorrhage, repair of intestines, and toilet of the contents.

"Antero-posterior perforation, if complete, can only fail to wound the small intestines when situated well on the outskirts of the surface of the abdomen; seemingly there can be no exception to this proposition, save in those extremely rare instances in which the perforating body traverses the cavity without injuring the contents.

"Penetration through the posterior walls of the cavity, if complete, with likelihood of laceration of important fixed organs, argues an injury of the most severe character, one in which the surgeon's aid will be of no avail in the majority of cases. The exceptions in which the severity will not prove insurmountable will be, transit through the space between the lower end of the kidney and the crest of the ilium, and in wounds occupying the outskirts of the entire posterior surface. . . . Many instances are recorded of recovery from posterior penetration of the large and fixed viscera of the abdomen without any surgical operation."

Question of the Advisability of Operative Interference.—Up to the time of the Boer War these wounds were considered to be almost necessarily fatal if an abdominal section were not immediately performed, death resulting usually from hæmorrhage or from septic peritonitis.

The results of abdominal wounds produced by the Mauser bullet have, however, produced practically a revolution as regards the question now under consideration. For it has been found that these injuries, when not immediately fatal, have been attended with remarkably good results under expectant treatment, recovery following in more than 60 per cent. of the cases, according to Mr. Spencer (*Med. Ann.*, 1901).

Sir F. Treves (*Brit. Med. Journ.*, vol. i. 1900, p. 1156) mentions cases in which the abdomen was completely traversed in various directions, and yet, in spite of prolonged exposure and tedious transport, recovery took place with only very slight symptoms. In the earlier part of the war he describes undertaking several abdominal sections, but he found that he was doing more harm than good, as the coils of intestine already adhered and sealed the wounds, there being no prolapse of mucous membrane or escape of intestinal contents. Treves concludes that it is impossible to operate in cases in which the abdomen is traversed above the umbilicus, owing to the multiple character of the injuries; whilst the cases in which the abdomen is traversed below the umbilicus get well without operation. He advises operation only when the bullet has escaped, and so its course is known, and when the general condition is good and there are signs of abdominal hæmorrhage continuing.

It must be remembered, however, that this refers only to wounds produced by bullets such as the Mauser, which does not spread on impact, is of small diameter, and has a great velocity. Where the bullet producing the wound is one which causes more damage than the Mauser, the expectant treatment is hardly likely to be successful, and in such cases it is certainly justifiable to urge *as early an operation as is possible, after the diagnosis of peritonæal perforation is made*. The exceptions would appear to be—cases where sufficient time has elapsed to allow of much extravasation, and the onset of a peritonitis which is certain to be fatal whatever is done; cases of injury to the spinal cord; severe wounds of the solid viscera; and those where such grave collapse, not due to hæmorrhage, is present as to make it certain that the needful interference with the contents of the abdomen will be necessarily fatal. With regard to the presence of peritonitis, the late Mr. Greig Smith wrote (*loc. supra cit.*, p. 704): "Undoubted and severe peritonitis existing on the second and third day is by most authorities recognised as a contra-indication. In such cases it is improbable that the sites of perforation could be found; and, if they were, that they could be dealt with without the production of excessive traumatism. There is little use in cleansing the cavity if it is to be at once refilled, and there is little use in looking for the perforations if they can neither be closed nor fixed in the wound, while there is positive danger in adding to the risk from traumatism. In such cases the most that can be done is to make a small parietal opening with the help of local anæsthesia, and permit the discharge of the noxious fluids, giving the patient the benefit of the remote chance of spontaneous cure with intestinal fistula."*

Prof. Nancrede (*Ann. of Surg.*, June 1887, p. 474) thus states the advantages of an operation:—"We can either forestall septic peritonitis or reduce its dangers to a minimum; we can prevent sapræmia—a common cause of death, as I believe. . . . . Should peritonitis have set in, we can afford sufficient drainage for the effusions, which may in themselves be already poisonous, or, as we have shown, will assuredly become the chief cause of danger; we can substitute for adhesions of doubtful permanency certain methods which secure the escape of the injured portions of gut into the lumen of the bowel; we can prevent the fatal results which must follow the casting off of a decomposing slough of a wounded portion of omentum or mesentery into the general peritonæal cavity; we can arrest hæmorrhage, which from its amount will prove fatal, or from decomposition will equally produce lethal results; we can restore the continuity of the gut, if it be nearly or completely severed, the former condition being not uncommon; we can avoid the risk of fæcal fistula . . . . and we can remove a hopelessly damaged kidney or spleen, and repair a wounded pancreas or liver."

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* Dr. Barnard (*loc. supra cit.*, p. 58) quotes Dr. Hamilton, of New York, as of opinion that operative interference is contra-indicated if forty-eight hours have elapsed since the accident.

Operation.—An excellent account of this will be found in the very helpful article of Prof. Nancrede to which reference has been already made.

With the utmost care the preliminary details of preparation are entered into first—viz., the cleaning and shaving of the skin, the providing of abundance of water recently sterilised by boiling, or a 2 per cent. solution of boracic acid, or a ¼ per cent. solution of salicylic acid. Plenty of sterile gauze lying in the hot sterilised water, to cover the intestines with. Abundance of ligatures of gut and silk, of different sizes. In addition to the usual instruments several pairs of Kocher's clamps should be at hand, or strips of gauze may be passed through the mesenteries and clamped with Spencer Wells's forceps.

"Now as to technique. The patient's limbs and trunk must be carefully wrapped in blankets, with towels, wrung out of the aseptic or antiseptic solution, tucked under and folded over them around the abdomen to prevent any accidental contamination of the peritonæal cavity. If not previously done, the urine should now be drawn off. . . . . Ether should be most cautiously administered. The incision should always be median,* as otherwise it is almost impossible to gain a proper view of the parts, and should usually extend from a short distance above the umbilicus to about two inches above the pubes. The abdomen having been opened, any clots or blood which obscure the operating field may be removed, but otherwise, unless it is manifest that severe hæmorrhage is going on, the small intestines,† which usually first present, should be carefully gone over, inch by inch, from the stomach to the ileo-cæcal valve, keeping them constantly enveloped in towels wrung out of hot water (sterilised); afterwards the stomach, spleen, liver, pancreas. large bowel, kidneys, bladder, omentum, mesentery,* and abdominal vessels must be examined. I do not mean that, if various wounds are discovered, say in the small intestine, and the place of exit of the ball from the abdominal cavity, all in such relations as would absolutely exclude injury of the stomach,† liver, kidneys, spleen, or bladder, such a detailed examination should be made—far from it, for every unnecessary manipulation is injurious; but I do advise that, rather than overlook a wound, much manipulation which the result proves to have been unnecessary had better be made. Of course the source of a severe hæmorrhage must be at once sought for, and any wounds of the hollow viscera ignored for the time being, care, however, being taken that the general peritonæal cavity is protected from fæcal extravasation by removing the intestines outside the abdomen, keeping them wrapped in warm, moist cloths; such hæmorrhage is, however, most unusual. Whichever plan is pursued, let everything be done methodically, and each injury repaired as it is detected, as this saves much time and renders any oversight almost impossible. All wounds of the bowel, however trivial, should be minutely cleansed, coaptated by the Lembert suture of fine silk introduced with an ordinary sewing-needle, and the suture line rubbed over with a little iodoform.* When necessary from the size or number of the wounds, a portion or whole calibre of the gut must be exsected.† Wounds of the liver, if situated at the free border of the organ, should, if possible, be coaptated with dry aseptic gut, which will soon swell and fill the track made by the needles. If this cannot be done, the hæmorrhage may perhaps be arrested by the judicious use of the thermo-cautery. Unless the bleeding be free, the wound should be plugged with an iodoform-gauze tampon, which is to remain for forty-eight hours, or may perhaps be carefully removed at the close of the operation, when, if the bleeding be almost entirely checked, the cautery may be used as a further precaution: if the flow be free, the tampon must be replaced and allowed to remain.

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* This point has been much disputed. No hard-and-fast rule should be made, but as a rule the incision should be median. The late Mr. Greig Smith pointed out that the following cases require it:—Cases where the ball has crossed the middle line, entering at one side and passing towards the other, and in others where the ball, entering near the middle line, passes either directly backwards or in an uncertain direction. I have alluded to this matter later (p. 288).

† Dr. Barnard (*loc. supra cit.*) points out that wounds of the duodenum are very rarely met with, and that wounds of the upper aspect of the transverse colon and of the omentum at this level are amongst the most difficult to discover.

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* "Wounds of the mesentery, when they are but perforations, can be passed without any additional interference, unless attended with hæmorrhage, in which case deligation of the injured vessel is required. Large lacerations should be closed with a running suture to avoid the future possibility of an incarceration and obstruction of a loop of the intestine in the opening. On account of the extreme delicacy of the membrane, its closure is often attended with some difficulty, which may be frequently overcome by introducing the sutures near the edge of a vessel, as this region affords the strongest grasp for the suture" (Shackner, *loc. supra cit.*). If it be the omentum which is wounded, or contains a large hæmatoma, it should be ligatured and cut away.

† Cases of wounds of all these viscera have been treated by laparotomy and suture. Thus, Mr. Dalton, of St. Louis (*Ann. of Surg.*, Aug. 1888), records a case of bullet-wound of stomach and liver thus treated successfully. The wounds in the stomach were those of entrance and exit, and situated, the former on the anterior surface, the latter near the upper border; both were closed with Lembert's sutures. The lower margin of the left lobe of the liver was ploughed through by the bullet an inch and a quarter from the transverse fissure, leaving a **V**-shaped wound half an inch in depth. This was closed by one catgut suture, of large size, passed on either side, an inch from the margin of the wound, and dipping deeply, on account of the great friability of the tissue, into the liver substance. "It acted well, bringing the wound together snugly." There were no other injuries save a slight contusion on the transverse colon, probably due to the spent violence of the ball, which was not found. The operation was rendered difficult by repeated vomiting of black grumous fluid, necessitating turning the patient on his side each time, "which was awkward with an open belly." The operation was a prompt one—two hours after the injury; recovery followed. In Dr. Keen's case (*Med. News*, May 14, 1887) the wound of entrance in the stomach was near the pylorus on the anterior surface, that of exit much more difficult to find, being on the lower border and posterior surface, and obscured by clot. Though there were other most serious injuries of superior mesenteric vein and right kidney requiring nephrectomy, the patient survived till the fifteenth day, death being due to diffuse suppuration of the clot in the mesentery, and gangrenous perforation at one spot in the intestine. Other means of meeting hæmorrhage from the liver are plugging with a tampon of aseptic gauze when the wound is large and the hæmorrhage great, and applying firm pressure, and, in the case of obstinate oozing from an abrasion, the application of a crystal of iron persulphate, or the Paquelin's cautery. Wounds in the gall-bladder are treated like those of intestine. Wounds of the kidney or spleen must be treated, according to their nature, either by styptic, cautery, or suture, as in the liver. If the hæmorrhage is too severe for the above, the organ must be removed. Dr. Keen, in his case alluded to above, the kidney being badly lacerated, adopted this step. The ureter should be examined, and, if found divided, sutured, or failing this the kidney should be removed.

"Wounds of the pancreas, spleen, or kidneys must be treated in a similar manner, or, if these measures fail, either spleen or kidney must be excised. Since a wounded splenic artery would lead to gangrene of the organ, it must be removed. The same advice holds good for wound of a renal artery, but in these cases death from hæmorrhage will usually result before art can intervene; still, such possible complications must be provided for. Wounds of the bladder had best be sewn with dry chromic and sulphurous acid gut, which, by its swelling, will fill the track of the little wounds; and the needle should be a round one, as small as can be made to carry the thread. Contused bowel will almost certainly slough, so that the injured portion had better be excised and the healthy peritonæal surfaces united by suture. Wounded or contused omentum or mesentery must also be excised, and the edges carefully united by interrupted sutures. The experience of at least one case has shown that since an omental slough cannot be eliminated into the lumen of the bowel, as occurs in wounds of the intestine, a fatal generalised peritonitis will result from the local gangrene. All bleeding must be checked, even from the smallest vessels, for quite extensive oozing will occur from most insignificant vascular orifices, because they are situated in a closed cavity, and, although the amount lost may not be dangerous *per se*, it will prove so as a source of septicæmia or peritonitis."

This was so in Dr. Keen's case (*loc. supra cit.*). The hæmorrhage here extended fan-shaped in a moderately thick layer between the two layers of the mesentery, its periphery extending almost two feet along the bowel, and its point being at the mesenteric attachment to the spine. The chief bleeding came from a hole in the superior mesenteric vein, and was secured, after much difficulty, by a laterally placed ligature of chromic gut. In spite of the most careful antiseptic precautions and unremitting after-treatment, the patient died, on the fifteenth day, of suppuration in this clot, and gangrene of the intestine connected with this part of the mesentery. Wounds of the spleen must be treated by the methods already given for the liver and kidney. The treatment of those in the bladder is given fully later.

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* Wherever possible, the sutures should be introduced parallel with the long axis of the intestine, as by this its lumen is least narrowed.

† Of all the wounds of the intestine those of the rectum are most difficult to detect, and therefore very fatal. Dr. Morton (*loc. supra cit.*) suggests that inflation with a rubber bag may be of assistance here. He also alludes to two cases in which the diaphragm was wounded. In each case a hernia of viscera into the thorax existed; this was reduced, the wound sutured with catgut, and recovery ensued.

"If a segment of bowel is to be excised, the cuts should be made at such points as correspond to the distribution of a large mesenteric branch in order to secure a due blood-supply to the edges of the incisions, and the parts to be removed should be laid upon a large flat sponge, or folded napkins, to prevent fæcal extravasation into the abdominal cavity. To avoid escape of fæces during excision of intestine, the simplest of all clamps is small rubber tubing made to pierce the mesentery on each side of the wound, at a spot devoid of vessels, passed round the intestine, and knotted once, or, better, clamped with Spencer Wells's forceps (Dr. Shackner, *Ann. of Surg.*, June 1890). To obviate kinking of the bowel, a V-shaped piece of the mesentery must be removed, the branches of the V not corresponding to the cut edges of the bowel, but presenting a free margin of one-eighth of an inch, lest want of vascularity cause failure of union at this the most doubtful point. After arresting hæmorrhage, the mesenteric wound must be carefully coaptated by numerous points of interrupted suture.*

"Should the pulse fail at any time during the operation, owing to irritation and paresis of the abdominal sympathetic, flushing the intestines and peritonæal cavity with hot water will often at once remove the unfavourable condition. The most scrupulous care must be exercised in the peritonæal toilet, which can be most quickly and effectively made by thorough irrigation of the cavity with warm sterilised water, and subsequent careful removal of all fluid in the ordinary manner by sponges, especial attention being paid to the case of the pelvis and the renal regions.

"When possible, the peritonæum should be united over the orifices of entrance and exit of the ball,† and a little iodoform rubbed in. . . . .

"When incipient peritonitis exists at the time of operation, with the probable formation of large quantities of acrid septicæmia or sapræmia inducing serum, drainage should in all cases be instituted. . . . The tube, preferably of glass, should have its end kept well down between the bladder and rectum in the male, or in Douglas's cul-de-sac in the female, with the external orifice plugged with iodoform cotton."

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* Where the security of the suturing of a severe wound of intestine is doubtful, Dr. Senn's plan of giving support by attaching a piece of omentum should be used (p. 267).

† If the track of the ball is likely to be septic, it should be treated by incision, cleansing, and drainage.

As many of the above points must be considered, till more cases give us better light, still *sub judice,* I have added, for contrast, the views of another American surgeon, Dr. McGraw, of Detroit (*Trans. Amer. Surg. Assoc.*, May 1889). It will be seen that in some most important points —*e.g.*, the site of the incision and the question of how best to examine the intestines—they are directly opposed to those of Dr. Nancrede. Dr. McGraw's chief propositions are as follows:—

(i.) Bullets which enter the abdominal cavity pass in a nearly absolutely straight line from the orifice of entrance to that of exit, or their final stopping-place in the viscera. (ii.) An incision made directly in the course of the ball will give the shortest route to the injured parts. If balls pass through the abdomen in straight lines, a cut over the path of a ball will open the nearest possible way to the wound underneath, provided the viscera have not shifted their places since the shooting. Even then they could be easily brought into the wound for the purpose of repair. Coils of viscera which could not be so brought could not possibly have been struck by the ball. (iii.) If a gunshot wound of the intestine will not under pressure permit discharge of its contents, it has been closed by the eversion of the mucous membrane or by the exudation of plastic lymph. In either case the wound would probably recover without suture if kept perfectly aseptic, and if the bowels are kept perfectly quiet. (iv.) An empty condition of the alimentary canal is most favourable for healing. To secure this as far as possible, it may be proper, in some cases of injury of the bowel after a hearty meal, to evacuate the stomach by a syphon. This would be especially indicated in wounds of the stomach, duodenum, and upper part of the jejunum, whether the surgeon does or does not decide on operative treatment. In small wounds of the stomach and duodenum, suture may sometimes be omitted if the surgeon can be assured that these viscera are empty. (v.) Senn's method of hydrogen-gas insufflation (*supra*, p. 188), however admirable in recent cases, should be used with great caution after the lapse of a few hours. The distension and motion of the gut caused by the insufflation might rupture inflammatory adhesions, break open intestinal wounds that had nearly healed, and make general a peritonitis which had become circumscribed. (vi.) The dangers of the operation are directly in proportion to its length and to the amount of evisceration. The length of an operation may be lessened—(1) By strictly limiting the examination of the viscera to such of them as may have been in the course of the ball. (2) By suturing wounds in the gut. wherever it is possible, instead of excising them. The latter should be reserved for wounds that do not permit inversion and suture. (3) By omitting all operative procedures, even suture, in all wounds which have become so thoroughly occluded by plastic material that the contents of the bowel cannot be passed through them. (4) When many wounds occur near together, by operating first on those wounds which imperatively demand it, and leaving to the last those which may recover without operation. If the stomach and intestine are both perforated, the small intestine should be first attended to, as the stomach, if empty, may recover without suture. So, too, large wounds should be sutured before small ones, discharging wounds before those which are occluded. (5) By never turning out all the intestines except, first, when hæmorrhage is otherwise uncontrollable; or, second, when there is evidently a discharging wound which cannot otherwise be found. "The examination of the whole intestine by slipping it, from one end to the other, through the fingers, though not causing the exposure of evisceration, nevertheless consumes an enormous amount of time, and reduces very materially the strength of the patient. In my opinion, surgeons have exaggerated the difficulties in the way of discovering wounds which have made this procedure necessary. The incision over the course of the ball will aid materially in the diagnosis by exclusion, for no intestine which cannot be brought into the path of the missile could possibly have been hit by it. It is not probable that a gut would slip more than three or four inches away from the place it occupied when wounded, and, with the incision I have mentioned, the necessity would rarely occur of examining any other viscera than those in the immediate neighbourhood of the wound. Let us suppose that a surgeon in operating has repaired all the wounds he has been able to find in or near the course of the ball; he has washed out the abdominal cavity; he has with his hands gently pressed upon all the viscera which could possibly have been injured, and his hands have come out unstained; he has, furthermore, with soft sponges wiped out the lower part of the abdominal cavity without finding blood or fæces. Shall he then, without any evidence whatever of an additional wound, subject his already exhausted patient to a most dangerous procedure on the mere suspicion that there might be a still undiscovered wound?"

It will be seen that the diversity of opinion as to the site of the incision, and the desirability of turning out all the intestines for examination, turns on the question of how best all injuries of the peritonæal sac can be detected. The advocates of the latter step and median free incision claim that by this alone can the needful inspection be made of all the viscera, both free and fixed, hollow and solid; they point to numerous cases in which even by this means of complete examination injuries have been overlooked that have marred the success of an otherwise complete and most hopeful operation; they hold that the median incision alone will meet those cases where the course of the ball is not direct, but erratic, or where, by moving the patient a long distance, or from peritonitis setting in late, peristalsis has altered the position of the bowels. Till we have more cases to guide us, I think the published evidence shows clearly that the median incision is the wiser, save in a few cases, as where the wound lies well away to one side, as here the colon may be found shot through, and only this organ and the contiguous small intestine and the kidney behind will require examination. It must not be forgotten that with the great advantage of more complete exploration which the median incision affords goes the greater risk of shock and of general contamination of the peritonæal sac, as coils which are possibly leaking are drawn up into the wound. This will have to be met by careful irrigation later. With regard to turning out all the intestines, the advocates of this plan claim that by this alone can all the wounds be found, and that this step, by the more rapid searching which it allows, in reality diminishes shock. Till more cases have been published—and surgeons owe a great debt to the candour and fulness with which the American surgeons have made known their failures as well as their successes—each case must be decided on its merits. The points which will aid the surgeon in coming to a decision on the above two steps are any obliquity of the wound of entrance, and of the course of the ball: the position of the wound of entrance, whether near the middle or the lateral parts of the abdomen; any evidence of its having passed from side to side; entire uncertainty as to its course; the time that has elapsed since the injury; the interval between this and the last meal; and whether the patient has been kept quiet.

In cases where the presence of multiple wounds, or the severity of one, entails the risk of sloughing, or where multiple suturing will produce dangerous stenosis, resection must be performed on the lines already fully given at pp. 259, 263. Two very interesting cases are recorded by American surgeons, in which Murphy's button was employed successfully. In one (Dr. G. F. Wilson, *Ann. of Surg.*, Sept. 1895), after one wound of the ileum had been found, and closed with Lembert's sutures, eight other openings were found, at a considerable distance from the first, three being very close together. Again, some little distance further off, the bullet had passed through the mesenteric border of the intestine, so interrupting the blood-supply that a slough would surely have resulted. A single resection was accordingly determined on, and the portion removed measured without stretching, just forty-three inches. The patient recovered, and the button was passed on the ninth day. In the second case (Dr. J. W. Walker, *Ann. of Surg.*, Jan. 1896), a resection of two inches of the ileum was successfully performed. The button was here passed on the fifteenth day. As Dr. Walker remarks, if Murphy's button be used at one place and another wound require suture lower down, any unavoidable constriction which the latter may occasion will cause anxiety as to the safe passage of the button.

The chief points in the after-treatment are—rectal feeding for forty-eight hours or longer if the stomach or upper part of the intestine has been injured; periodic emptying of the drainage-tube with a syringe, or even irrigation through it; morphine injections, combined with atropine (about $\frac{1}{60}$ gr.), for the first thirty-six or forty-eight hours, rather than opium; cold to the abdomen by means of an ice coil; careful use of saline aperients—*e.g.*, Seidlitz powders—a little later.

I append the following as instances of what injuries the surgeon may expect to have to deal with:—Bullet wound near umbilicus; seven openings in alimentary canal, viz., three openings close together in the small intestine (three and a quarter feet below the duodenum), two openings in the descending colon, and two in the rectum; no great extravasation; also a large vein wound in the mesentery; death from peritonitis; bullet found near ischial spine (Annandale, *Lancet*, April 15, 1885). Pistol wound near navel; seventeen hours later, operation (two pints of bloody serum let out, with small clots, but no fæces); seven penetrating wounds of intestine, six in the small, one in the sigmoid containing the bullet; all the openings plugged with ragged, everted mucous membrane; no fæcal escape till edges were separated; careful suturing and toilet; recovery after a very critical condition for a week

(Bull, *Ann. of Surg.*, May 1885). Bullet entrance close to navel: operation two hours later; abdominal cavity full of blood; a spurting artery in the mesentery; eleven wounds requiring suture in small intestine, and two in ascending colon; no fæcal extravasation, but a melon-seed body found and removed; on the thirteenth day great rectal tenesmus led to discovery of blood-effusion in pelvis; three pints let out by incision about two inches within anus; recovery; bullet passed per anum (Hamilton, *Journ. Amer. Med. Assoc.*, Aug. 22, 1885; *Ann. of Surg.*, Nov., 1885). Bullet entrance three and a half inches above umbilicus, and just to left of middle line: operation within twenty-four hours; rent in omentum close to great curvature of stomach, and two linear rents in this viscus, found with much difficulty; operation had to be concluded quickly from patient's critical condition; death from acute peritonitis within a few hours; four wounds found in upper part of jejunum, all within a distance of three inches (Briddon, New York Surg. Soc., Dec. 8, 1886; *Ann. of Surg.*, April 1887). Bullet wound two inches above and two inches inside right anterior superior spine: operation in nine hours; wound found in ascending colon, pouring out fæces; another wound in colon, also pouring out fæces; both sutured; recovery (McGraw, *Chicago Med. Journ. and Exam.*, July 1887; *Ann. of Surg.*, Dec. 1887).

A very complete table, containing 234 cases, is given by Dr. T. S. K. Morton (*Journ. Amer. Med. Assoc.*, Jan. 4, 1890); others by Sir W. MacCormac and Mr. Barker will be found in the *Brit. Med. Journ.*, May 11, 1887, and March 17, 1888.

More recent papers will be found in the *Annals of Surgery*. One of the most interesting is by Dr. A. B. Miles (vol. ii. 1893, p. 623). Thirteen cases are given, with five recoveries. In proof of the severity of these cases, of the recoveries one patient had sixteen, another fourteen, and a third ten wounds of the small intestine. One of the fatal cases was due to the discharge of both barrels of an ordinary shot-gun into the right iliac fossa.

RUPTURE OF THE INTESTINE.

The following remarks are taken from the Cartwright Prize Essay by Dr. B. F. Curtis, of New York (*Amer. Journ. Med. Sci.*, Oct. 1887): *Relative frequency of rupture*, in 113 cases.—Duodenum, 6; jejunum, 44; ileum, 38; "other parts of small intestine," 21; large intestine, 4. While the duodenum and large intestine escape from their sheltered position, the jejunum is most frequently ruptured in its first three feet, the ileum in its last three. Fæcal extravasation is almost invariably present. The most frequent and important complication of ruptured intestine is laceration or contusion of the mesentery; this is important from the rapidly fatal hæmorrhage, or later, gangrene. The cases of ruptured intestine fall clinically into three classes. (A) The shock never leaves the patient, may never lessen, but pass, rapidly or slowly, into fatal collapse. This may be due to (1) the shock of the accident; (2) to hæmorrhage; (3) to fæcal extravasation. (B) Those in which evident peritonitis develops. The diagnosis is easiest in these cases, but unfortunately they are not the most common. (C) The most common. Instead of evident peritonitis setting in after reaction has taken place, vague symptoms appear, keeping the surgeon in expectation of it, but giving nothing on which he can found a positive diagnosis, for the same slight indications are common in cases in which ultimate recovery has taken place. Patient is apathetic, seemingly satisfied with his condition, and thus misleading; or, getting gradually weaker, and therefore being less able to complain, appears to be improving. Peritonitis in this group of cases develops so slowly that its beginning cannot be noted. *Duration of life.*—The average taken from 113 cases is forty-eight hours. *Chief points in the diagnosis of rupture of intestine.*—Cause, *e.g.*, a kick. This was so in 28 per cent. of the cases. The intestine is crushed between the spine and the force employed. The severer the injury—*e.g.*, a kick by a horse—the more likely is the intestine to have been injured. Rigidity of the abdominal wall, and pain and tenderness at one spot, are the most reliable symptoms. Tympanites, a later sign,[*] is of grave omen, as it greatly embarrasses operative interference. Shock[†] and vomiting afford less valuable evidence, unless persistent. The absence of each has led to fatal delays. A certain diagnosis is seldom possible for twelve hours or longer, but the surgeon should not wait on this account. The risk nowadays of doing harm by exploring, in cases where no laceration of the intestine or mesentery is present, is much less than that of waiting to explore until the onset of a septic peritonitis affords certain evidence. As in intestinal obstruction, abdominal section is the only means of clearing up the diagnosis.

Mr. Robson (*Clin. Soc. Trans.*, vol. xxi. p. 130) advises as follows on the question of operation: "In cases of doubt one is so prone to wait, hoping for the turn of events, and then to arrange to operate, when too late, that it is well to have some formulated rule, and for my own guidance I have adopted the following. In cases where there is a reasonable belief that the intestine is wounded, exploration by a small median incision must be made, when, if there is any rupture of the bowel, flatus, or serum tinged with blood, or fæculent material will escape through the small peritonæal opening, which can be enlarged and necessary treatment adopted; but should no flatus or fluid appear and the peritonæum prove to be healthy, the small wound can be closed."

That the best chance is afforded by early operation as soon as the period of shock has passed off, is proved by recorded results (Battle). This surgeon points out (*loc. infra cit.*) that in the second paper read before the Clinical Society (*Trans.*, 1890) by Mr. Croft, out of fourteen cases then collected only one was completely successful, a case operated on by Mr. Croft; and, between 1890 and 1894, Mr. Battle had collected fifteen cases, seven of which recovered.

Treatment.—Where rupture of intestine or severe hæmorrhage is probably present, exploration should take place as soon as the period of shock has passed away. The incision should be median and a long one, at least four inches, the parietes here being normal, not distended and atrophied as in abdominal tumours. When all the intestine has to be drawn out and examined—and no operation can be otherwise complete—the incision should be eight inches long. In any case the centre should be at the umbilicus, unless it is clear that it is the stomach that is injured. It should not be lower down, or the attachment of the mesentery may interfere with the pulling out of the intestine, especially if it be short and thickened with fat. Blood may show through the peritonæum before this is opened. When this membrane is incised a sponge should be passed in on clamp-forceps to search for blood, fæces, or pus. If hæmorrhage is going on, the opening the abdomen may stop it (Parkes, *Med. News*, May 17, 1884), or it may increase, causing grave symptoms. If blood well up, a hand should be passed in, under the omentum, upwards and backwards, to make pressure on the abdominal aorta and root of the mesentery. All the small intestine is then turned out into hot aseptic towels; bleeding points are found, and secured with clamp-forceps while the pressure is relaxed to note the effect on the bleeding. The bleeding having been arrested, any injury to the intestine is sought for. If a rupture is found, the part should be kept outside in a hot aseptic towel, while the rest is returned. If hæmorrhage is slight or absent, the intestine should be drawn out loop by loop, and inspected till the whole is examined. Fæcal extravasation should be avoided by extremely careful handling of the intestine, the wound thus remaining unsoiled. When all the intestine has been inspected, the peritonæal sac should be carefully cleansed as at p. 215. Any distended coil may be aspirated, and the puncture tied up or opened as at pp. 177, 214. If the large intestine be much distended, a long rectal tube may be passed and manipulated along through the walls of the intestine. Small ruptures will often admit of suture without resection. Other viscera may be injured and have to be dealt with (*vide supra*, p. 285). When the case is too grave to admit of resection being performed and of the necessary plastic repair taking place, the best course is to make an artificial anus by closing the ends of the intestine with ligatures or clamps, then having thoroughly cleansed the peritonæal sac, next bring the ends out and insert Paul's tube (pp. 226, 258), or suture the ends of the intestine to the margins of the cut parietal peritonæum, and trust to the presence of these sutures and plenty of iodoform, to hold the ends of the emptied intestine in place until the adhesions are firm. This course ought not to take more than half an hour. Where the injury is high up in the intestine, additional risk must be run in order to avoid, by resection, the artificial anus which is so harmful here. If the anus be made use of, it should be closed as early as possible, or the nutrition will suffer fatally (p. 276). Saline infusion may be resorted to with great advantage, early in the operation, before collapse, perhaps irrecoverable, has set in. No operation should be performed if marked collapse is present. If the patient does not respond to stimuli, he will not survive laparotomy.

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[*] When present early and abolishing the liver dulness this is almost pathognomonic of injury to the alimentary canal.

[†] Shock is quite unreliable, as it depends not only on the severity of the injury but on the idiosyncrasy of the patient.

The following are some of the conditions which have been met with in exploration of injury to the intestine.

In Dr. Wiggins' case, to which I have already alluded, thirty-six hours after the boy had been kicked by a horse, the abdomen was opened and the small intestine withdrawn and carefully examined, beginning with the ileo-cæcal region. Near the jejunum a bruised and livid knuckle was discovered. Though no perforation was made out in it prior to the resection, a small perforation was found afterwards near the mesenteric border. About six inches were resected, the ends being united by Maunsell's method. Owing to the patient's "coming-to" and straining while the resection was being performed, blood and fæcal matter escaped into the peritonæal sac, this accident being due to the safety-pins used as clamps being too large. A 50 per cent. solution of hydrogen-dioxide was poured in, and allowed to remain while the ends were being united, and the cavity was afterwards flushed with, and finally left full of, sterilised salt solution. The patient, a boy aged 15, made a good recovery (*New York Med. Journ.*, Jan. 20, 1894).

In a case fully reported by Mr. Battle (*Lancet*, vol. i. 1894, p. 1121, a paper which will well repay perusal), the following was the condition present when the peritonæum was opened.*

A gush of blood followed, and, as the patient was straining, a coil of intestine was forced out. A rent was found in the mesentery of this coil, bleeding freely. While this hæmorrhage was being arrested with clamp-forceps, the open end of a piece of intestine sprang into the wound. The other end was found by tracing the mesentery along. This portion of mesentery was much contused and lacerated, and there was a second complete rupture about eight inches from the first. Only a small portion of the contents had escaped, among which were one or two partly digested beans. As it was evident that the condition of the mesentery would result in gangrene if it were left, resection was performed, nearly thirteen inches being removed with a large wedge-shaped piece of mesentery. While a lateral anastomosis was being performed here by Senn's method, it was discovered that a third rupture existed about a foot beyond the second. This rupture was not quite complete. It was closed "by means of Senn's plates, cut to the required size, and a ring of Lembert's sutures used to further strengthen the union."† The patient did well until the fifth day, when evidence of perforative peritonitis appeared. The abdomen was again opened, and it was found that the end-to-end union had broken down, leading to leakage. An artificial anus was made, but the patient never rallied.

Mr. Croft has recorded two cases of rupture of the small intestine without external wound (*Clin. Soc. Trans.*, vol. xxi. p 254, and vol. xxiii. p. 141). These must be looked upon as pioneering cases, as far as this country goes, in the modern treatment of these injuries. Both patients recovered—the one completely, after primary enterorraphy by Lembert's method; in the other case an artificial anus was made. This was closed by resection of the intestines, four weeks later, but the patient sank, thirteen hours after the operation, from exhaustion, due chiefly to "the irrepressible escape of intestinal contents at the artificial anus." The following points amongst many others are noteworthy in the two last instructive cases:

In the first case, three separate lesions were discovered; the ileum had been ruptured transversely for two-thirds of its circumference at the junction of its upper and middle thirds. There was a laceration of an inch and a half in the mesentery in the same neighbourhood, and a considerable rent in the omentum above the level of the umbilicus. Fæcal peritonitis had spread from the ruptured intestine into the iliac umbilical, and hypogastric regions, eighteen hours and a half having elapsed between the injury and the operation. The peritonæum was very carefully irrigated with warm boracic acid solution (from 16 to 20 per cent.), and the edges of the ruptured intestine brought out into the wound. Mr. Croft points out that the result of this case shows that it would probably have been a safe practice to have trimmed the edges of the ruptured gut and completed an enterorraphy by Lembert's sutures, as the irrigation was evidently efficient. This would have saved the inanition and debility consequent on the establishment of an artificial anus, the external irritation and the septic condition of the parts around the opening, and the second long and risky operation required to close it.

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* The patient, aged 24, had been kicked in the abdomen by a horse. He was admitted into St. Thomas's Hospital shortly after, and was operated upon about six hours later when the shock had passed off.

† This operation lasted over two hours, and, owing to the increased shock, five pints of saline solution were injected with a good effect.

In the second case, fourteen hours had elapsed between the operation and the kick from a horse. A faint fæcal odour was observed when the peritonæal sac was opened, and about an ounce and a half of fæcal fluid was found extravasated between some coils of intestine adherent to each other and the omentum. On tearing through the adhesions and separating the coils on the right side, about two inches below the umbilicus, a small rupture was found in the ileum, situated in an areola of inflamed and ecchymosed tissue. Resection of the damaged intestine was performed, the ends being united by about forty Lembert's sutures. The peritonæal sac was carefully purified with a hot 20 per cent. solution of boracic acid. The patient, aged 14, made an uninterrupted recovery.

I can only find space for one other of these most interesting cases. It is recorded by Mr. W. T. Thomas, Assistant-Surgeon to the Royal Infirmary at Liverpool (*Brit. Med. Journ.*, vol. i. 1894, p. 1355). It presents the following points of interest :—

(1) The slightness of the injury. The patient, aged 55, had, twenty-four hours before the operation, struck her abdomen against a chair which she was carrying before her, and which caught against a doorpost. (2) The absence of symptoms in a case of severe septic peritonitis, only distension and tenderness being present. When the abdomen was opened, about half a pint of putrid serum, with large yellowish flakes of puriform lymph, escaped. The intestines were all distended, and, as no collapsed coils could be found, the small intestine was withdrawn. After two feet had been examined, a perforation was found* about three-quarters of an inch long, from which oozed fæcal fluid. This was closed by two rows of continuous Lembert's sutures, the mucous membrane being carefully tucked in. Thorough irrigation with a 1 per cent. solution of carbolic acid was then carried out, a glass tube being left in. The patient made a good recovery.

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* The site of the rupture was not given. Nor is it stated whether much difficulty was met with in dealing with the distended intestines.

CHAPTER VII.

OPERATIONS ON THE STOMACH.

GASTROSTOMY. — GASTROTOMY. — DIGITAL DILATATION OF PYLORUS.—PYLOROPLASTY.—EXCISION OF PYLORUS.—GASTRECTOMY.—GASTRO-JEJUNOSTOMY.—DUODENOSTOMY AND JEJUNOSTOMY.

GASTROSTOMY.

Indications.

1. Certain cases of cancerous stricture. This also includes invasion of the œsophagus, secondarily, from primary cancer of the mediastinal glands, &c. 2. Cancerous disease of the pharynx; and, in a few cases, malignant disease of the tonsil or back of the tongue not admitting of operation.

A very interesting case is given by Mr. Whitehead (*Brit. Med. Journ.*, July 22, 1882). Here, in a patient aged 40, excision of the tongue had to be followed by tracheotomy and gastrostomy, owing to the original extent of the disease. At the last report the patient was alive, four months after the gastrostomy, five after the removal of the tongue. Two such cases are given by Mr. Stonham (*Lancet*, Oct. 2, 1886). One patient survived four months; the other, one. In this case the growth was so extensive as to necessitate tracheotomy at an early stage of the gastrostomy. Both patients experienced great relief. Tracheotomy was also required in Mr. King Green's case (*Lancet*, Feb. 3, 1883), though here the disease was either in the pharynx or upper part of the œsophagus. I think that in such cases, also, the last few months of life might often be rendered much more comfortable by a timely gastrostomy.

3. Cicatricial stricture, whether traumatic or syphilitic.

The first of these, from its frequency, requires separate notice.

1. Cancerous Stricture. — Here several points call for attention. Amongst the chief are—the question of the treatment of œsophageal cancer by passage of tubes or gastrostomy; the mortality of the latter operation; and the best date for performing it.

Between treatment by gastrostomy and that by tubes no fair comparison can be made, because the former operation has, in such a large number of cases, been performed under most unfavourable conditions. Much too often it has been put off till the patient, scarcely able to swallow liquids, is just kept alive by enemata. Such patients, worn out by the miseries of slow starvation, often with secondary disease and lung and pleural trouble, are not in a condition to be submitted to abdominal section, and are not likely to respond to the call made upon their vitality to unite two serous surfaces firmly together, on which depends the success of the operation. I do not think that I exaggerate if I say that, in a distinct proportion of the cases in which the surgeon is asked to perform gastrostomy, the hand of death is already on the patient, and something next door to the decomposition of the grave has already set in, owing to the extension of the disease.

In advising gastrostomy, each case must be decided on its merits; the patients here are not only adults, but well on in life, and, when assured that the end is certain, the surgeon may, in most cases, having put all the risks before the patient, leave it to him to decide. But I think that if the patient, having previously declined it, only asks for operation when it is clearly too late, the surgeon should be firm enough to decline to operate where, on every ground, his interference will be hopeless.

The following points help in a decision between gastrostomy, bougies, and tubage: i. Food taken.—As long as pulpy, semi-solid, or a proportion of solid food is taken, the occasional passage of a bougie should be persevered with. But when the patient is becoming restricted to liquids, a tube should be introduced, or failing this a gastrostomy performed. When the patient is fed by enemata only, and merely takes ice by the mouth, it is too late to operate. ii. Amount of pain felt with and difficulty in passing bougies or tubes.—Any sensation of a rough, raw surface, any blood or broken-down tissue on the bougie, increased expectoration, dyspnœa, paroxysmal cough (this may occur after even a teaspoonful of fluids), fœtor of sputum or bougie, make it evident that the passage of instruments causes advance of ulceration and sloughing; when this is increasingly accompanied with pain and evidence of laryngeal irritation, gastrostomy should be proposed. iii. Site of stricture.—The lower down this is, the more difficulty will there usually be in dealing with it by dilatation, and the nearer are important parts. iv. Condition of patient.—Here the rate of emaciation must be watched—anything like loss of one to two pounds a week is very ominous. How far is the strength preserved? how far does the patient tend to give up his life-habits? how far is he bed-ridden? Where the pulse is thready, the extremities cold, the temperature never up to normal, the case has gone too far. v. Condition of viscera.—Evidence of implication of trachea or bronchi, of pleuritic effusion, and of broncho-pneumonia must be sought for. If there is reason to believe that the growth has extended beyond the œsophagus, operation should usually be declined. vi. Rank of life.—A patient who can afford all the luxuries of life, and who can have everything done to palliate his condition, is, obviously, in a very different condition to one in a humbler position.

I would thus sum up this question of gastrostomy or tubage:—As long as a patient can swallow sufficient food by this means, treatment by tubes and bougies is far preferable. Whenever they can be introduced, the tubes ingeniously devised by Mr. Symonds[*] are to be preferred. These have a funnel-shaped extremity resting on the upper end of the stricture, are introduced on a whalebone guide, and are kept *in situ* by a loop of silk which is passed round the ear. They have the great advantage of allowing the patient to swallow his saliva and food, and thus retain the pleasures of taste. If the silk break, great trouble may accompany the removal of the tube.

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[*] *Clin. Soc. Trans.*, vols. xviii. p. 155, xxii. p. 306; *Brit. Med. Journ.*, April 23, 1887. See also Dr. Rodman's two cases, *Brit. Med. Journ.*, May 25, 1889. It is clear from these cases that patients can be kept alive as long and gain weight equally by tubage as by gastrostomy, and that in some cases even a malignant stricture can be dilated.

If a larger pattern of bougie is needed, none is more suitable than the flattened bulbous one, ending in a conical point, of Mr. Durham.[*]

Any surgeon treating cancerous stricture here by dilatation must remember that treatment of cancer in this way is contrary to what is generally practised, and is only justifiable here on special grounds—*e.g.*, the fatality of the disease and the risks of gastrostomy; that these risks have been enormously increased by the way in which this operation has been deferred; that in these cases a time may come when tubes can no longer be made use of; and that if gastrostomy has been deferred till now it can only be performed with greatly increased risk. In other words, the patient should understand that if he shuns the risks of an early operation, he renders himself liable to other but as serious risks by deferring it till an hour when he can only ask for it, and the surgeon only attempt it, as an almost utterly forlorn hope.

The question of which gives the greatest comfort cannot be answered dogmatically. But no one who has seen many cases of gastrostomy, and met with a fair proportion of success, will hesitate to prefer the result of this, if performed early, with its gain of weight and freedom from pain and irritation during the few months which in any case remain, to the passage of tubes necessarily more and more frequent and difficult as the case progresses, with the not infrequent distress and choking when they are introduced, the blockage of the hollow ones by sputum or food, and the needful withdrawal and re-introduction, easily effected, no doubt, for some time, but ever irritating and fretting the growth.

I have performed gastrostomy twelve times, in each case for cancer of the œsophagus: in six patients the operation was asked for too late; in one, my seventh case, the patient died from an accident, for which I am responsible; the other five recovered well. One, a young married woman, had had symptoms six months; she was in the fourth month of pregnancy when operated on: she lived in comfort for six months, and died of extension to the lung, a month after giving birth to a child at the full time. Another patient lived between three and four months, and would have survived longer if it had not been for his carelessness as to exposure. A third was alive and progressing satisfactorily when last heard of four months after the operation. The fourth is still alive, four months after his operation. The fifth made a good recovery, but I lost sight of the case nine weeks after the operation.

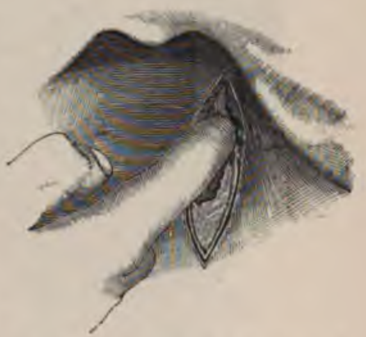
On the other hand, the passage of tubes, where there is considerable narrowing, clearly requires some force, and thus needs skilled and very careful hands. Even in such hands, fatal mischief has been inflicted. Furthermore, the blocking of the smaller tubes, which alone will pass in the later stages through tight and ulcerating strictures, may necessitate frequent changing, irritation, and thus hastened sloughing of the growth. The close contiguity of this to the trachea, pleuræ, &c., must not be forgotten.

[*] *Syst. of Surg.*, vol. i. p. 798. The bougies are made by Kröhne and Hawksley.

Operation (Figs. 116–122).—Those precautions being taken against shock, such as warm wraps, hot-water bed, table, or bottles, ether is given if the condition of the lungs admits of it, and if it is quietly taken without troublesome, heaving breathing. The surgeon will usually find it most convenient to stand on the right side and to have his patient drawn over to this side of the table. The shoulders should be somewhat raised and the hips slightly flexed, to relax as much as possible the tension of the soft parts, which often fall with embarrassing sharpness over the epigastric angle from the prominent ribs down to the wasted, retracted umbilical region (Fig. 116).

Mr. Howse (*Dict. Pract. Surg.*, p. 590) recommends the following incision: (1) An oblique one, about two inches and a half long, parallel with and about one inch below the lower margin of the left costal cartilages. This incision should start about an inch and a half from the middle line, and its length must depend on the varying development of the rectus muscle. It should not go higher than the above point, as it will not leave enough free skin and muscle between the cartilages and the incision to fasten the sutures to. This first incision is only to be carried through the skin and fascia. When made, the sheath of the rectus will be seen at the inner end, and at its outer end a portion of the linea semilunaris and of the external oblique. The usual plan of continuing the operation is to have the muscles and fasciæ of the abdomen incised in the same way as the superficial parts. Mr. Howse prefers to continue the operation as follows: (2) The lips of the wound being separated towards the inner part as widely as possible by retractors, a vertical incision is made in the sheath of the rectus a little distance from its outer margin. The vertical fibres of this muscle will then be seen, and these should be separated, not cut, with a steel director, and the posterior part of the sheath exposed. This may then be incised vertically.

FIG. 116.



The finger searching for the stomach through a vertical incision.

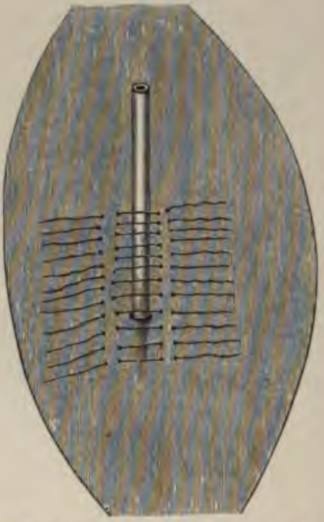
From my experience of twelve cases I prefer, as simpler, a single vertical incision (Fig. 116) beginning opposite to the end of the eighth ntercostal space and passing down for three inches over the rectus—e., about two inches from the linea alba. The fibres of the rectus, being xposed, are torn straight through with a steel director, and the posterior, omewhat concave, layer of its sheath exposed. This is carefully divided or the full length of the incision, and the extra-peritonæal fat (if present) and the peritonæum picked up and opened together. A finger s now introduced (Fig. 116) to feel for the stomach.

As a rule, the contracted stomach lies high up under the left lobe of the liver, and requires to be hooked downwards and forwards into the wound. Not infrequently the great omentum presents first, and it is easy, by seeking too low down, to draw up the colon. In case of difficulty the best plan is to find the anterior border of the liver, trace up the under surface to the portal fissure, and thence along the lesser omentum to the stomach. This is told by its thicker, more substantial feel, and pink-red colour.

The stomach being drawn up, a part is chosen on its anterior surface, free from vessels, and as near as possible to the cardiac end.

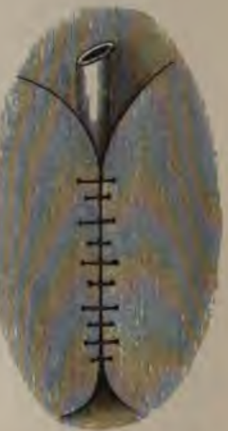
A number of different methods of completing the operation have been devised, the object being to produce a valvular opening into the stomach and thus prevent constant leakage and its attendant troubles. The methods described below are the most satisfactory, and each of them has strong supporters, the advantages claimed being the formation of a satisfactory valve and the absence of leakage. Dr. Dennis (*Ann. of Surg.*, Nov. 1899, p. 633) describes a very satisfactory result in a case of cicatricial stenosis of the œsophagus, operated upon by Marwedel's method two years previously. The man could remove and insert the tube without any trouble, and there was no leakage when the tube was out.

FIG. 117.



Witzel's method of gastrostomy. Lembert's sutures have been so placed in the walls of the stomach as, when tightened, to draw two folds of the walls of the stomach over the tube. (Meyer.)

FIG. 118.



Witzel's method of gastrostomy. Sutures tied and the tube embedded in the walls of the stomach. (Meyer.)

The results obtained by the methods of Albert and Ssabanijews-Franck are very satisfactory, these methods having, moreover, the great advantage of being extremely simple and quickly performed.

i. WITZEL'S* METHOD (Figs. 117 and 118).—The peritonæum is opened either by the incision parallel to the left border of the ribs, or, as I prefer (p. 299), by one through the rectus muscle. The stomach having been drawn out, a very small opening is made near

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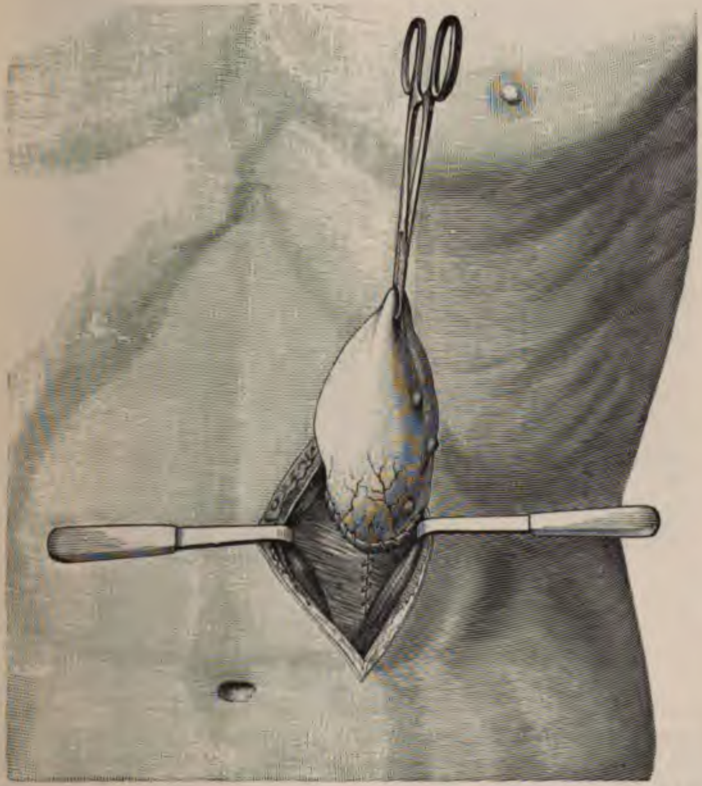
[*] *Centr. f. Chir.*, 1891, p. 601. An interesting account of this method, from which Figs. 117 and 118 are taken, is given by Dr. W. Meyer (*Ann. of Surg.*, vol. i. 1893, p. 592). Witzel gives two successful cases. Dr. Meyer quotes Mickulicz as having operated five times successfully, and as recommending Witzel's method as the best.

its cardiac end, and a snugly-fitting rubber tube introduced, and then buried in the wall of the stomach for about two inches by Lembert's sutures, two folds of the stomach wall being stitched over the tube, as seen in Figs. 117 and 118. The free end of the tube is then brought out of the wound, while the area around it is stitched carefully to the peritonæum on either side of the wound in the parietes. Prof. Keen (*Ann. of Surg.*, vol. ii. 1893, p. 639) thus managed this part of the operation:—The tube having been sutured into the stomach, three sutures were inserted into the walls of this viscus, but not tied before it

FIG. 119.

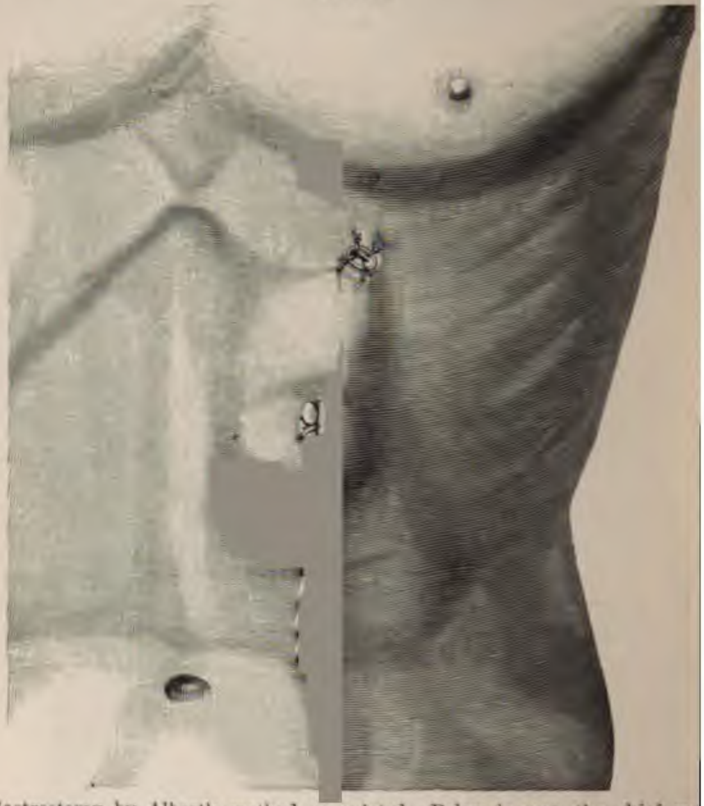


Albert's method of gastrostomy. The stomach is drawn upwards, while below the peritonæum and deeper layer of the sheath of the rectus have been stitched to it by a continuous suture. Retractors hold the fibres of the rectus apart. (Kocher.)

was returned within the abdomen, the needles being left threaded. As soon as the stomach was replaced these needles were thrust through the abdominal wall, and the stomach brought up to the margins of the opening. The edges of the wound having been sutured, the upper end of the tube may be closed with a clip, and the usual dressings applied. Feeding by the stomach is begun at once. Any leakage is prevented, not only by this oblique entrance of the tube into the stomach, but, as shown by a specimen obtained from a patient of Dr. Meyer (*loc. supra cit.*), by the fact that Witzel's ingenious method of stitching the stomach walls over the tube causes a short artificial cone to pr obliquely into the lumen of the stomach.*

ii. METHOD OF ALBERT (Figs. 119 and 120).—The peritonæ opened either by an incision parallel with the costal cartilages, one just within the linea semilunaris high up. The stomach been drawn out, a long conical diverticulum of the anterior wall viscus is pulled well out of the wound, and the parietal peritonæu

FIG. 120.



Gastrostomy by Albert's method, completed. Below is seen the chief wo closed by a continuous suture. Above is the small opening through which stomach has been opened. (Kocher.)

the posterior layer of the sheath of the rectus are sutured round it care being taken not to constrict it too much (Fig. 119). A cont suture is used, and every care taken not to perforate the mucous the stomach. A small incision is now made through the skin above the front and on the level of the costal cartilages. Th between the two openings having been separated from the sub parts, the diverticulum of the stomach is drawn up under the ski over the costal cartilages as far as the small skin incision, to the edges of which its apex is united by a few sutures. A small opening is next made here into the stomach, and the orifice fixed to the skin by one or two points of suture (Fig. 120). The lower part of the wound is then closed by a continuous suture. As a result the diverticulum of the stomach is drawn upwards, its base is gripped by the muscular fibres of the rectus, while a short upward-directed subcutaneous œsophagus is also formed. All escape of fluid is thus prevented and the patient can be safely fed at once.

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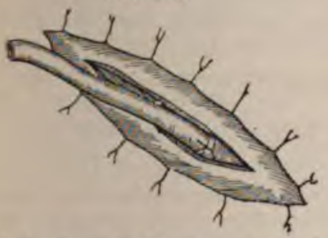
* Another advantage of Witzel's method is illustrated by one of his case patient who had been operated upon for cicatricial stricture of the œsophag fistula closed spontaneously within sixteen days after the stricture had been and the tube removed from the stomach (Meyer).

The Ssabanijews-Franck method is very similar to the above, the upper opening being, however, here made one inch or one inch and a half above the vertical incision and not over the costal margin. The valvular aperture so formed is seemingly as efficient as in Albert's operation, although the length of the canal is rather less.

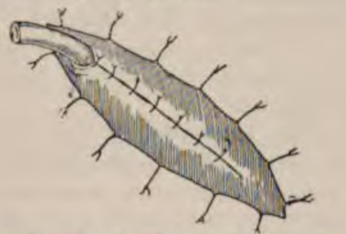
iii. MARWEDEL'S METHOD (Figs. 121 and 122).—The stomach is exposed and attached to the abdominal incision by a continuous suture. The serous and muscular coats are then incised vertically to the extent of about two inches, and dissected from the mucous membrane on either side. A small incision is then made through the mucosa at the lower end of the incision, and a rubber tube introduced and fixed by a suture. The tube is then laid vertically along the mucous membrane, and the incision in the serous and muscular coats closed over it as shown in Fig. 122. An oblique valvular aperture is thus produced.

FIG. 121.



Gastrostomy by Marwedel's method
First stage.

FIG. 122.



Gastrostomy by Marwedel's method;
Second stage.

iv. ABBE'S MODIFICATION OF KADER'S METHOD (*Ann. of Surg.*, Jan. 1899, p. 113).—Here a circular valve is formed in the following manner:—Through the abdominal incision a conical portion of the wall of the stomach is withdrawn, and its edges sutured to the parietal peritonæum. Two, or even three, concentric purse-string sutures are then passed circularly round the protruding cone. A small incision is now made at the apex of the cone, through which a tube is passed. The nearest purse-string suture is now drawn tight round the tube, and the latter then pushed inwards till the next suture comes into contact with it, when it is also drawn tight. In the same manner, the third suture is drawn round the tube after further inversion. The external wound is then closed. Feeding through the tube is commenced at once. After a week or ten days the tube becomes loosened, and is then only passed at meal-times. The inverted cone here forms a circular valve which effectually prevents regurgitation. This was so in each of six cases described by Dr. Abbe, and in one case, in which death took place from hæmorrhage from the growth four days after operation, there was not the slightest leakage when the valve was tested by hydraulic pressure.

For the first few days milk and brandy, just warmed, and peptonised if preferred, should be the chief food, given with the yolks of one or two eggs. A little later beef-tea, soups, well-pulped vegetables, with plenty of fluid, should be given. In Mr. Howse's words, "When the larger sizes of tubes have been introduced, solid food may be poured into the stomach by the aid of a large wide-mouthed syringe. This food should be minced meat, with a certain proportion of vegetables, all finely ground in the mincing machine."

Patients are often very ingenious in feeding themselves. Some, to enjoy the taste of food, have masticated solids and then passed them through the fistula.*

If the operation has been deferred till too late, and it is absolutely needful to feed the patient at once, the best method will probably be either Franck's or Kader's. If the opening is deferred, a small amount of liquid may be introduced every few hours through one of the large hypodermic syringes made for exploration, and holding a drachm or two. The puncture must be repeated at each occasion of feeding, obviously a risky proceeding.

Dilatation of Strictures of the Œsophagus from below through an Opening in the Stomach.—Where non-malignant strictures low down in the œsophagus resist dilatation from above, and the patient is losing ground, the stricture may be attacked from below in one of the following ways:—

(i.) **By Gastrotomy**, the opening being closed at the same time. Prof. Loreta, of Bologna, operated on the first case in 1885.†

The patient, aged 24, had swallowed caustic alkali. Attempts to dilate the stricture by bougies were unsuccessful, and at last it became impossible to pass any instrument. The point at which the sound was arrested seemed to correspond with the fourth dorsal vertebra. The patient was entirely unable to swallow, and emaciation had become extreme. Eleven months after the injury an incision about five inches long was made from the xiphoid cartilage downwards and to the left. Some difficulty was met with in finding the stomach, owing to its contraction and the way in which the liver overlapped it: but at length the operator succeeded in drawing the greater part of the stomach out of the wound, and a longitudinal incision was made through its walls between the two curvatures, having its upper end as near the cardia as possible. The next step was to find the orifice of the œsophagus, in order to introduce the dilator; but this involved considerable difficulty,‡ and the search was interrupted by a considerable quantity of bile, which regurgitated from the duodenum into the stomach. At length, by searching with the left index between the under surface of the liver and the small curvature of the stomach, the end of the œsophagus was found. Then the distended stomach was kept drawn down by an assistant while the operator introduced a dilator (something like that of Dupuytren for lithotomy). The wound was then sewn up and the stomach returned. The patient rallied well, and in six hours swallowed some soup, with the yolk of an egg, to his great joy, as for twelve months he had been unable to do more than swallow mouthfuls. Recovery is stated to have been complete.

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* Thus, Mr. Durham (*Syst. of Surg.*, vol. i. p. 803; *Lond. Med. Rec.*, March 1878) mentions a patient of Trendelenburg's who, after masticating his food, spat it into a funnel, and then forced it on through a tube into his stomach. Two of my later patients have fed themselves after this fashion through a tube.

† An excellent summary of Prof. Loreta's cases is given by Mr. Holmes (*Brit. Med. Journ.*, Feb. 21, 1885).

‡ See the directions given at p. 307.

Mr. Kendal Franks has related an instructive case of the same kind Ann. of Surg., vol. i. 1894, p. 385):—

Here the whole of the right hand was introduced into the abdomen, and the index nger into the stomach through an opening an inch long situated about midway tween the curvatures and the orifices. As the finger could only just reach but not late the stricture, an Otis's dilating urethrotome (the blade having been removed) as guided by the finger into the stricture, screwed up, and withdrawn fully expanded. ter this had been done both laterally and antero-posteriorly, an œsophagus bougie uld be easily passed through the stricture from above. The wound in the stomach as united with two continuous sutures, one uniting the mucous membrane, the other, Lembert's method, the peritonæal coat. The patient made a good recovery. Large-zed bougies could be passed without difficulty or pain.

It is clear that the above method may be resorted to with great enefit in non-malignant strictures, low down in the œsophagus where e dilated condition above the contraction makes it very difficult to t this off with a bougie.

(ii.) **By Gastrostomy.**—This, while rendering manipulations safer in measure, cripples the surgeon's movements, as it will be impossible, owever much the fistula be dilated, to get the finger passed through anywhere near the stricture in the œsophagus.

Instrumental dilatation can alone be made use of through a gastric stula, and for this reason the method by two stages is inferior to e other. It has been most ingeniously used under the following rcumstances:—

In 1889, Hagenbach (*Correspondenzblatt Schweizer Aerzte*, No. 5) directed a patient ith a non-malignant stricture of the œsophagus to swallow a small shot attached to a ng thread. This was drawn out of the stomach through the fistula, and a strong silk read fastened to it and drawn up through the mouth. To the lower end a bougie as tied, and increasing sizes were daily drawn through the fistula.

Dr. R. Abbe, of Newport (*Ann. of Surg.*, vol. i. 1893, p. 489), advises hat he calls the "string" method in the treatment of dense fibrous trictures. A gastrostomy having been previously performed,* a small um-elastic bougie is guided through the stricture from below up into e mouth, and a stout silk ligature passed in the same way. This lk being see-sawed backwards and forwards, the stricture is felt to ield, and larger bougies can then be passed.

Difficulties in and after Gastrostomy.

i. The very prominent angle formed between the ribs and the sunken mbilical region (p. 299). ii. Hæmorrhage. This will be almost *nil* the rectus fibres are separated with a director, and the veins on the tomach carefully avoided. iii. Finding the stomach. iv. Drawing his up into the wound if itself affected by disease, as when the primary isease is situated very low down in the œsophagus, or if it is adherent y reason of secondary deposits. v. Jerking breathing due to the næsthetic. vi. Completing the second stage of the operation. vii. ntense pain on introducing food into the stomach.

In a patient of Mr. Butlin's (*Brit. Med. Journ.*, April 14, 1883) this was found to be he case, the patient dying nearly a month after the operation. Mr. Butlin attributes his pain to his opening having been close to the pylorus.

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* In this and the preceding instance the gastrostomy opening should be placed as igh up as possible. In his case Dr. Abbe opened the œsophagus near the root of the eck as well as performing a gastrostomy.

If it is thought that the opening is made too near either extremity of the stomach, it would be well after feeding to keep the patient turned on to the opposite side. viii. Leakage of gastric juice and regurgitation of food. This is an extremely troublesome complication, leading, as it does, to most rebellious dermatitis.

Causes of Death after Gastrostomy.

1. Inanition and exhaustion, the operation being performed too late. 2. Peritonitis. 3. Extension of the disease to surrounding parts—*e.g.*, trachea, bronchi, etc. 4. Lung affections—*e.g.*, pneumonia due in part to the operation—viz., the anæsthetic and enforced recumbency, and in part possibly to the saliva, which cannot pass down the œsophagus, being drawn into the air-passages, either before or during the operation. 5. Hæmorrhage—*e.g.*, from ulceration into aorta or lung. 6. Acute gastritis. 7. Suppuration between stomach and liver, and due probably to irritation round one of the sutures.

GASTROTOMY.

Indications.—The operation may be required for the removal of foreign bodies which will not pass through the pylorus, such, for instance, as forks, as in MM. Labbé's and Péau's cases, and masses of hair as in Thornton's (*Lancet*, Jan. 9, 1886) patient. Increasing pain, vomiting, emaciation, and sufficient time having elapsed to allow of the body passing, will be the chief indications. In a very few cases gastrotomy will be required also for the removal of foreign bodies impacted low down in the œsophagus. It is also indicated in certain cases of severe gastric hæmorrhage, and for the dilatation of fibrous strictures of the œsophagus (*vide supra*, p. 304).

Operation.—A. FOR REMOVAL OF FOREIGN BODIES FROM THE STOMACH.—Such cases as Mr. Thornton's show that this operation can be safely performed at one stage.

The parts being cleansed and the abdomen relaxed, one of the following incisions is made:—(1) Over the body itself, when this can be felt. (2) In the case of a large body, in the middle line, from the xiphoid cartilage down to or below the umbilicus. (3) One of the incisions given for gastrostomy—*e.g.*, one parallel with the left costal margin and about an inch below it, reaching from a point near the xiphoid cartilage obliquely downwards and outwards to a point opposite to the ninth rib. One of the first two will probably be the best. The abdominal wall having been divided, and the peritonæum opened, the exact site of the foreign body is made out. If this be pointed, great care must be taken not to let it damage the stomach during the needful manipulations. In such cases the external opening must be free, that the surgeon may see what he is about. In the case of such a body as a fork the blunt end must first be found.

When the surgeon has decided where to open the stomach, he brings this part out of the wound and packs sterile gauze all around it, so as to steady it, and also to shut off the peritonæal sac.

The stomach is now opened with scissors by an incision transverse to its long axis, and of length adapted to the case. As far as possible, any vessels must be avoided, but any that bleed will at once be commanded by Spencer Wells's forceps. The body is next extracted with suitable forceps or a scoop, care being now taken not to damage the stomach, especially if the foreign body has set up inflammation or ulceration, and to allow no blood or mucus to escape into the peritonæal sac.

After the removal of the foreign body, if the stomach contains much mucus or blood, this may be removed by gentle sponging. The aperture in the stomach is then closed with Lembert's or Halsted's sutures, and the wound sutured.

B. For Removal of Bodies—*e.g.*, Tooth-plates—impacted in the Lower Part of the Œsophagus.—These cases, though rare, are so difficult as to call for some remarks here. Prof. Richardson, of Harvard University, first brought forward a very successful case of this operation (*Lancet*, 1887, vol. ii. p. 707). A plate carrying four teeth had been impacted eleven months in a patient aged thirty-seven. Numerous attempts had been made to remove it from the mouth. The plate was successfully removed by gastrotomy, by an incision six inches long parallel to the lower margin of the left ribs. The following interesting details are given:—

Determination of the Site of the Foreign Body.—In an individual of average height, and with a neck of ordinary length, the distance from the incisors to the diaphragm is fourteen and a half inches. All parts of the œsophagus are accessible to the finger either by gastrotomy or external œsophagotomy. With the right forefinger introduced by œsophagotomy and the left by gastrotomy, it was found possible, not only to make the fingers touch, but in many cases overlap. But these results are only approximate, as it would not always be possible to do both operations on a patient. It is possible to reach with the left hand three inches above the cardiac opening—*i.e.*, the length of the left middle finger. From above, through the wound in the neck, one cannot reach quite so far on account of the sternum and clavicle. Allowing in the average neck one and a half to two inches from the cricoid cartilage to the lowest point of the wound in the œsophagus, we have the average distance from that incision to the cardiac opening of five and a half or six inches. If the obstruction be less than six inches from the cricoid, an attempt should be made to remove it from above; if more than this, or thirteen inches from the teeth, gastrotomy should be performed. The incision that, on the whole, is recommended is an oblique one below the margin of the left ribs. The stomach being drawn up into the wound, it is most essential to put the lesser curvature on the stretch, so that it makes a straight line to the diaphragmatic opening. The cut through the stomach wall must be far enough to the right to allow the passage of instruments along the sulcus between the anterior and posterior walls of the stomach, made tense as above. If the instrument is brought obliquely to this groove and passed upwards, all the time being pressed gently against the straightened lesser curvature, it will glide into the œsophagus every time with the greatest ease. The opening in the stomach should be first large enough to admit instruments; if these fail, it must be enlarged, and the whole hand introduced.

In the following case I was much less fortunate, owing to the way in which the tooth-plate was jammed above the cardiac orifice. While such cases are rare, they are most important, on account of the numerous difficulties which they present.

E. W., aged 44, was sent to me at Guy's in May, 1895, having swallowed a vulcanite tooth-plate, which "stuck in his throat." The plate originally carried seven, but now only two teeth. A medical man whom he saw at once pushed the plate down with a bougie. An emetic which had been given then acted and brought up some blood. The patient complained of constant pain in the epigastric region just below the xiphoid cartilage, and in his dorsal vertebræ. Swallowing was painful and so was eructation of gas, though this gave relief. Patient was able to swallow food quite well. He was not troubled by vomiting. A bougie could be passed into the stomach, but just before it entered it rubbed over a foreign body. The body did not yield in the least to any force which I thought it justifiable to use with the bougie. On June 11, I operated as follows: The stomach having been washed out with dilute boracic acid, an incision three inches and a half long was made, parallel with the linea alba, commencing on the level of the xiphoid, and about an inch to the left of it. The rectus, the sheath being opened, was split with a steel director. The stomach was very small and pale. Sponges having been packed around, it was opened, with scissors, just to the right of the cardiac end, and as high up as possible. The opening was about a quarter of an inch long. Three small vessels sprang, and were tied. The exploring finger detected the body imbedded just above the cardiac orifice. The mucous membrane around felt pulpy and swollen. Numerous curved forceps were introduced by the opening, and then along the lesser curvature, but, though the body was repeatedly seized, I was quite unable even to loosen it. This was due to its not presenting any projecting points and to the swelling of the mucous membrane around. I next enlarged the opening in the stomach so as to introduce my hand, but, though with the tip of the middle finger I was able to reach the plate, I was unable to dislodge it. Mr. Durham and Mr. Davies-Colley also tried, with a like result. Moreover, to steady it, Mr. Tubby was good enough to keep the end of an œsophageal bougie pressed against it from above. I closed the lower two-thirds of the wound in the stomach with Lembert's sutures of fine silk, and stitched the remaining part to the upper part of the parietal incision, so that other forceps might be tried later on. The patient, however, never rallied completely, and sank about forty-eight hours afterwards. At the post-mortem examination the coronary arteries were found in an advanced stage of atheroma. There was no peritonitis or escape of gastric contents. The mucous membrane near the cardiac orifice of the stomach presented a ragged appearance dating to the prolonged manipulations. The plate was very firmly fixed in the œsophagus, one inch and a half above the cardiac opening.

C. For certain Cases of Severe Hæmorrhage from a Gastric Ulcer.—A considerable number of these cases have been operated on, with a fair measure of success, although at the present time the exact indications for operation and the best methods of dealing with the ulcer cannot be said to be finally settled.

The following are a few of the cases that have been reported; they give some idea of the various means that have been adopted:—

Roux (*Revue de Gynécologie*, 1897, p. 113) reported two successful cases. In the first he ligatured the bleeding vessel and then excised the ulcer; and in the second he ligatured the artery at the two ends of the lesser curvature without removal of the ulcer. Guniard (*Thèse Trognon*, Paris, 1893) performed gastro-enterostomy for a bleeding pyloric ulcer, with recovery. Kuster (*Ann. of Surg.*, Aug. 1894) cauterised the ulcers in two cases, and in each also performed gastro-enterostomy, with recovery. Korté (*Proceedings of the German Surgical Congress*, 1897) cauterised an ulcer which could not be extirpated, the patient dying eight days later, a perforation of the splenic artery being found at the necropsy. Mickulicz (*Thèse de Marion*, Paris, 1897) reported two cases. In the first he excised the ulcer, and the patient recovered; in the second he used the cautery, the patient dying the same evening. Cazin (*Presse Médicale*, 1899, p. 31) reports a case in which he found four erosions. These were sutured with catgut, and the patient recovered without further hæmorrhage. In a number of cases the operation failed owing to inability to discover the ulcer. Finally, in an exhaustive paper by Drs. Andrews and Eisendrath (*Ann. of Surg.*, Oct. 1899) from which the greater part of the following is gathered, two brilliantly successfu cases operated upon by Dr. Andrews are described, the plan adopted here being ligation of the ulcer *en masse* within the cavity of the stomach.

The ulcers which give rise to serious hæmorrhage are usually situated on the posterior wall of the stomach, and nearer to the lesser curvature than the greater. The character of the ulcers is very variable. They may be small and quite superficial, when the bleeding commonly arises from vessels in the submucous layer; or they may be deep and adherent to structures outside the stomach, leading to ulceration of large vessels, such as the aorta, or the hepatic, coronary, splenic, or pancreatico-duodenal arteries. It should also be borne in mind that in a number of cases more than one ulcer or erosion was present. Leube and Kocher give as indications for operation recurrent severe hæmorrhages when careful dieting, rest, and other medical measures have failed. A single profuse bleeding is not necessarily an indication for operation, because a second hæmorrhage may never occur.

Operation.—The incision must be free, and should in the first instance be median. If this does not give sufficient room, the left rectus may be subsequently divided. The chief difficulty is the finding of the ulcer. The anterior surface and the two curvatures of the stomach should be first systematically examined for any indurated spot; then the posterior surface is reached and examined by passing the hand through a hole in the great omentum. If no external guide to the position of the ulcer is found in this way, Andrews and Eisendrath recommend the examination of the interior of the stomach through a vertical incision in the anterior wall, this incision being so placed as to avoid as far as possible any large vessels which are visible. Before this incision is made, the stomach must be withdrawn from the abdomen as far as possible, and carefully isolated with sterile gauze. The whole interior of the stomach is then carefully and systematically inspected, a strong electric light being essential. Andrews and Eisendrath carry this out in the following manner—"The hand is passed behind the organ through the opening in the omentum already mentioned. The posterior wall is now pushed forward into the opening and passed portion by portion into plain view. This may be continued until the whole posterior wall to the cardiac end has been gone over. The greater and lesser curvatures and the remainder of the anterior wall may in the same manner be caused to invert and pass in review beneath the opening, the latter being caused by traction to assume various positions to assist in this invagination. Should the posterior wall be adherent to the pancreas, as in Case I. and somewhat immovable, that particular part of the viscus should be inspected by reflected light. In such a case the lesser peritonæum should be opened, which will give additional access to the posterior wall. We now come to a portion of the stomach interior which cannot be drawn down or forward—namely, the cardiac end, where it is covered by the left lobe of the liver and attached to the diaphragm. To inspect these parts it is necessary to illuminate the cavity, and retract the liver and costal arch. The Trendelenberg position would probably be of assistance at this stage, both in gaining access and in the matter of illumination. With care a good view can be obtained of the whole cardiac end and opening." The treatment of the ulcer when found must vary according t the conditions present. If the ulcer is quite small and superficial i may be cauterised. In all other cases it should, if possible, be excised. Excision, however, will not be possible when the base of the ulcer i adherent to parts outside the stomach, and when it is situated at th pylorus. In the former case it may, if possible, be ligatured *en masse* as Andrews (*loc. supra cit.*) did in his two successful cases; failing this, gastro-enterostomy must be performed. In the latter case, also recourse should be had to gastro-enterostomy (*vide* p. 327).

DIGITAL DILATATION OF THE ORIFICES OF THE STOMACH.

We owe this operation to Prof. Loreta,* of Bologna, whose two first cases Mr. Holmes was, I believe, the first to bring prominently under the notice of English surgeons.

It has since been almost entirely replaced by the operation of pyloroplasty (p. 312); but in a few cases of benign stricture of the pylorus, unsuitable for pyloroplasty, it will still be useful; for instance, where the pylorus is embedded in adhesions, or is very rigid.

Operation.—The stomach should be well washed out a few days before, and also on the morning of the operation, with dilute solutions of boracic or salicylic acids,† and the time fixed should be as early as possible in the day. The previous meals should be fluids, small in amount and readily digested. The skin being cleansed, an anæsthetic given, and the parts relaxed, an incision about five inches long is made either in the linea alba or on the right side of the middle line, from a point about one inch below and outside the xiphoid cartilage to one just below the cartilage of the ninth rib. Hæmorrhage having been arrested, the peritonæum is opened, and one or two fingers introduced to feel for and examine the pylorus. No definite tumour will probably be felt, but distinct hardness of the pylorus. If the omentum is adherent to the stomach, it must be separated after both this and the pylorus are drawn out of the wound. Gauze is now most carefully packed around the pylorus, and the stomach is opened with blunt scissors, about the centre of its anterior aspect, but rather nearer to its pyloric end. Any bleeding points having been secured by Spencer Wells's forceps, the right index examines the condition of the pyloric orifice. While attempts are made to dilate it, this part of the stomach is steadied by the left hand. Much gentleness and patience must be used in applying the great force which is often required for dilatation. Mr. Haggard, finding that he could not introduce his finger, used a pair of dressing-forceps, and, having thus started the dilatation, followed it up by the passage of a female urethra dilator (probably having guarded the blades with drainage-tube), and dilated gradually till he was able to get his "index and next finger into the duodenum without feeling them at all tightly packed." Prof. Loreta, in his first case, having introduced his right index, found that "no force that could be safely used succeeded in dilating it till the left index was also introduced and employed to steady the pylorus. When this was done, the end of the right forefinger was gradually squeezed through the aperture. Then the finger was used to hook down the pylorus towards the abdominal wound, a manœuvre which enabled the operator to get the left index also through the pylorus. But it was still exceedingly difficult to effect any separation of one finger from the other, so great was the resistance, not only of the sphincter itself, but also of the coats of the stomach and duodenum. The attempt at dilatation threw the muscular fibres into spasmodic action, which quite overcame all the force that could be exerted. Three such attempts were made in vain, but then the pylorus began slowly to yield to the force employed, which was very considerable. At length a sensation was experienced, 'showing that the tissue was so far distended that it could not obey the dilating finger further without being torn.' The fingers were now kept apart for a short time, and the spectators noted that one finger was about eight centimetres (more than three inches) from the other."*

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* Prof. Loreta's first case is reported in the *Lancet*, Aug. 18, 1883. The ninth operation, one of dilatation of the cardiac orifice, is briefly given in the same journal April 26, 1884. Mr. Holmes' summary, a very full one, of two papers by Prof. Loreta, will be found in the *Brit. Med. Journ.*, Feb. 21, 1885. Any surgeon about to perform these operations should refer to this. Mr. Haggard's case—the first successful one performed by an English surgeon—was published in the *Brit. Med. Journ.*, Feb. 19, 1887. In the same journal for March 17, 1888, is a note that the patient continues perfectly well.

† In one case, that of Mr. Pearce Gould's (p. 312), the use of this even was followed by temporary ill effects. As long as the washing out is thoroughly done, boiled water used tepid will be quite efficient.

The wound in the stomach is next closed with Lembert's suture of carbolised silk; or the method employed by Mr. Thornton (p. 306) may be made use of. The sutures should pass through any points that still bleed after forci-pressure is stopped. If any ligatures are really required, fine chromic gut should be used. Perhaps the introduction of a sponge during the insertion of the sutures may facilitate this step by everting the mucous membrane. When the stomach is soundly closed, all gauze is removed from the peritonæal sac,† the viscus replaced, and the wound in the abdomen carefully closed. It should be noted that in Mr. Haggard's case "terrific bleeding followed the incision" into the stomach, and was difficult to arrest completely during the suturing of the stomach. Pure blood was vomited on the third day, and about two teaspoonfuls on the sixth. As Sir F. Treves points out (*loc. infra cit.*), if care is taken to make the opening in the stomach only large enough to admit the index finger, it will be securely plugged.

The after-treatment will consist in rectal feeding for the first few days, feeding by the mouth then being cautiously commenced. Prof. Loreta feeds his cases by the mouth very early, if needful—"on the fourth day" (Haggard); according to his own paper, on the same evening. in his first case, he gave, every half-hour, teaspoonfuls of the yolk of an egg beaten up with Marsala. The condition of the patient, and the way in which enemata are retained, must decide this point. If the suturing be efficient, a little milk and barley-water with a few drops of brandy may be given six hours after the operation.

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* However the dilatation is effected, it should be kept up for several minutes.

† If any cleansing of the peritonæum is required, this will be done now. To prevent any chance of leakage, sutures should be placed at the very angles of the wound, or even beyond them (Fig. 55).

PYLOROPLASTY.

This is a scientific advance on Prof. Loreta's operation for the relief of non-malignant strictures of the pylorus, *e.g.*, those due to congenital stenosis, corrosive poisoning, injury, cicatrised ulcers, and chronic gastritis. We owe the operation to Heineke and Mickulicz, who performed it independently in 1886 and 1887.

In pyloroplasty a definite plastic operation replaces a divulsion performed more or less in the dark. The two operations are very well contrasted by Mr. Pearce Gould in an instructive paper (*Lancet*, 1893, vol. i. p. 1183):—"Of the two methods of obtaining a wider pylorus, pyloroplasty was chosen as safer and more likely to be permanently successful than Loreta's operation of divulsion. Both operations entail incision into the stomach and subsequent suture of the wound; so far their perils are the same. But whilst pyloroplasty consists of a clean cut through the anterior wall of the pylorus, where it is most free from large vessels and under the operator's eye, the effects of divulsion are not seen and may be more or less than the surgeon intends, and may be inflicted upon important vessels. The statistics of Loreta's operation show cases of death from complete rupture of the pylorus on its posterior aspect, and also from hæmorrhage; the plastic operation is entirely free from these dangers.* A further most important consideration is the question of relapse. Divulsion has been followed by recurrence of the stricture, and in many cases the operation has been repeated; and, looking to analogous cases, this is what one would expect. A sudden dilatation of the strictured urethra or rectum is well known to be followed by relapse unless special means are used to maintain the enlargement. All such special means are inapplicable in the case of the stomach. Stretching the pylorus may consist of over-stretching the muscular ring, analogous to stretching the sphincter ani. This may be entirely satisfactory in its result; on the other hand, it may effect a tearing and stretching of fibroid or cicatricial tissue—a process known to be very unsatisfactory in many cases. Pyloroplasty, on the other hand, introduces new and presumably healthy tissues into the pyloric ring, tissues with no tendency to contract. In this connection it is interesting to remember the results obtained by the free division of the palmar fascia in Dupuytren's contraction. Not only is the shortened fascia lengthened, but the indurated tissue softens down and all signs of the malady may disappear."

Operation (Figs. 123 and 124).—The preliminary treatment as to diet, and washing out the stomach, is that given at p. 310. The abdomen having been opened by a free incision either in the linea alba or semilunaris, and all hæmorrhage stopped, the pylorus is found, brought out of the wound if possible, and in any case well packed around with tampons of iodoform or sterile gauze. Adhesions between the pylorus and omentum, or between the pylorus and the liver, may need separating. A transverse incision is then made into the anterior wall of the stomach, just internal to the pylorus, by which the stricture is examined from within. The incision is next prolonged transversely through the strictured pylorus into the duodenum, making it about two inches long. Any vessels which spirt must be clamped. Any contents of the stomach which may escape are carefully removed on gauze. The transverse incision is then widely opened out by two blunt hooks, placed in the centre of each side; this produces a wound of lozenge shape, which is united so as to form a vertical one. Any soiled sponges or tampons being renewed, the sutures are inserted in a double row.

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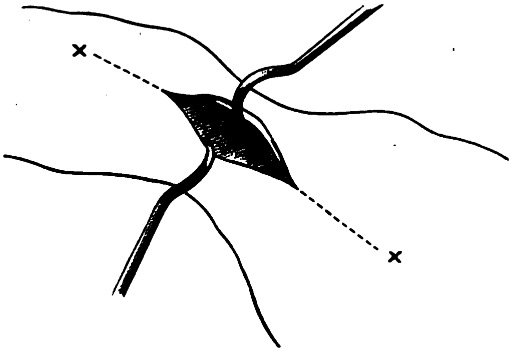
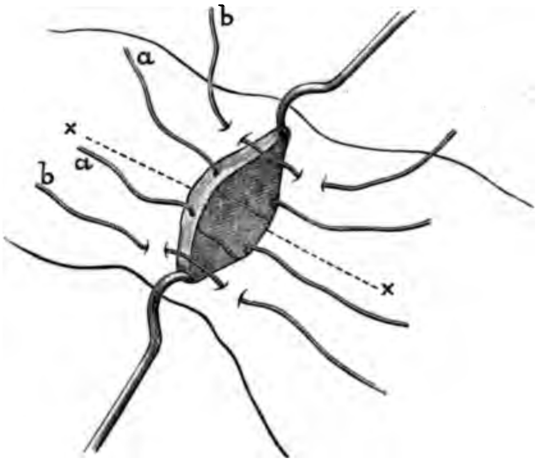
* Mr. P. Swain, of Plymouth, whose operative experience is well known, has candidly published (*Lancet*, 1892, vol. i. p. 87) two cases of digital dilatation of the pylorus which ended fatally. Both patients were in very weak condition; one died of continued vomiting. In the other, the duodenum, which was very thin, was torn quite through, behind, at its junction with the pylorus.

FIG. 123.



Pyloroplasty, first stage, showing the longitudinal incision. (Pearce Gould.)

FIG. 124



Pyloroplasty, second stage, showing the longitudinal wound converted into a transverse by retraction. (Pearce Gould.)

There are several ways of doing this. A continuous suture uniting the mucous membrane and a row of Lembert's sutures (Fig. 55) carried well into the muscular coats would be simple and efficient. Fine silk should be used on ordinary round sewing-needles. To strengthen the line of suture any tags of peritonæal adhesions which have been separated and left attached near the incision may be brought together and fixed over it by a few points of suture. The after-treatment will be that given at p. 311.

Successful cases will be found recorded by Mr. Page, of Newcastle (*Lancet*, 1892, vol. ii. p. 84); Mr. Gould, *loc. supra cit.;* Mr. Morison (*Lancet*, 1895, vol. i. p. 396). Mr. Gould quotes several foreign operators, and, having collected twenty-three cases, finds the mortality to be about 25 per cent. Mr. M. Robson (*Brit. Med. Journ.*, 1900, vol. i. p. 627) makes use of his decalcified bone bobbin (p. 241). This, besides steadying the line of sutures for twenty-four or forty-eight hours, secures an immediately and thoroughly patent channel. The same author (*loc. supra cit.*) also remarks as follows on the limitations of this operation:—"If, owing to cicatrisation of the ulcer, there is extensive hypertrophy of the pylorus with a large amount of thickening, pyloroplasty is insufficient, as in such cases contraction will be likely to recur. Here pylorectomy may be performed, as in two cases of my own, or, better still, gastro-enterostomy, which is a simpler, quicker, and safer operation. Numerous and firm adhesions, active ulceration, and the presence of new growth, are also contra-indications for pyloroplasty. Pyloroplasty with partial excision seems the right practice in bad organic stricture. The dense tissue being cut away, the lozenge-shaped incision can be readily sutured so as to become transverse; whilst if a simple longitudinal incision is made through the tissues of a dense stricture, it is impossible to convert it safely into a transverse line of sutured wound, owing to the great tension if the two ends be made to meet in the middle."

PYLORECTOMY. EXCISION OF THE PYLORUS.

This operation, which we owe especially to German surgeons—*e.g.*, Billroth, Wölfler, Gussenbauer, and v. Winiwarter—has not hitherto been so largely practised in England as elsewhere. The principal indication is malignant disease, although the operation has occasionally been performed for non-malignant stenosis of the pylorus (*vide supra*). The original method of end-to-end direct suture has been largely replaced by the more expeditious methods, in which the divided ends of the stomach and duodenum are closed by suture, and a gastro-duodenostomy or gastro-enterostomy then performed. On several occasions also the operation has been performed in two stages—the gastro-enterostomy being first performed; then, after the general condition of the patient has improved as a result of the relief from pyloric stenosis, the removal of the pylorus is carried out. This has been done by Tupolske, Hahn, Franke, Barker, and others. Mr. Mayo Robson (*loc. supra cit.*, p. 696) objects, however, to this plan, on the ground that the patient may derive so much benefit from the first operation that he cannot be always brought to see the necessity of a second operation until it is too late to be successful.

The improvements in technique have led to a considerable diminution in the mortality, as may be gathered by a comparison of the following sets of cases collected in 1885 and 1900:—

Mr. Butlin quotes Bramer (*Cent. f. Chir.*, 1885, p. 548) as having collected seventy-two cases of pylorectomy for cancer, of which fifty-five died from the operation, a mortality of 76 per cent.

Mr. Mayo Robson (*loc. supra cit.*) gives a table containing 572 cases, with 174 deaths, a mortality of 30·4 per cent. Some operators have, moreover, published recent lists showing far better results than even this. For instance, Maydl had only four deaths in twenty-five cases, and Kocher only five deaths in fifty-seven cases.

As regards the question of pylorectomy compared with gastro-enterostomy only, the following words of Dr. Macdonald's (*Ann. of Surg.*, Feb., 1901, p. 160), referring to the results of pylorectomy, may be quoted:—"I have taken occasion recently to make a cursory investigation of the literature with relation to this subject, and have been able to find forty-three cases for which pylorectomy was done for carcinoma of the stomach, and that the patients were living without recurrence three years after the operation, and that there were patients in this group who were alive ten years after the primary operation, without symptoms of recurrence. I may also say that this group of forty-three cases is collected from among 527 operations done for the relief of pyloric carcinoma, with an immediate mortality of 31 per cent. In other words, we have from the work already done rather more than 8 per cent. of final recoveries as judged by ordinary standards. This will compare very favourably with the ultimate success which we enjoyed a few years ago in the treatment of cancer of the breast."

Before deciding between a pylorectomy, on the one hand, and a gastro-jejunostomy only, on the other, the following conditions must be most carefully considered:

i. The size, fixity, and degree of displacement of the pyloric growth. Is the mass small, circumscribed, and localised to the pylorus?—*i.e.*, how far is it (*a*) without any secondary deposits? (*β*) free from adhesions? It is probably quite impossible to be certain as to these points. While in many cases cancer of the pylorus may remain long limited to the pylorus itself, it is very liable to infect the omenta and the lymphatic glands around the head of the pancreas, and to cause secondary growths in the liver and other parts.* Adhesions, too, are very frequently† met with between the stomach and the colon, pancreas, and liver. The following cases show how easily the surgeon may be mistaken in regard to these points. In Mr. Southam's patient (*Brit. Med. Journ.*, July 29, 1882—an instructive paper, from which I shall again quote later), aged 43, though the hard nodular mass in the situation of the pylorus moved with respiration, and shifted as the patient moved from side to side, though the symptoms were only of four months' duration, and the disease appeared to be limited to the pylorus, there was a mass of enlarged glands surrounding the head of the pancreas, and some slight adhesions of the stomach to these. Mr. Morris mentions a patient of Prof. Lietherin's in whom, though the growth could be easily moved in different directions, it was found so firmly adherent that the operation had to be abandoned.

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* McArdle (*Dublin Journ. Med. Sci.*, vol. lxxxiii. p. 511), having collected from the statistics of different writers 1342 cases, states that the pylorus alone was involved in 802, or over half the cases.

† The statistics of Gussenbauer and Winiwarter (Langenbeck's *Arch.*, Bd. xix. p. 372, 1876) show that, of 542 cases of cancer of the pylorus, adhesions were present in 370.

ii. The strength and age of the patient. The general condition, power of repair, &c., must be sufficient to justify the patient being submitted to an operation on very vital parts, which will certainly take an hour and a half, and may take between two and three hours.

iii. The rate at which vomiting, pain, and emaciation are increasing. Where this is marked, pylorectomy should be abandoned.

iv. The amount of dilatation of the stomach, and how far this yields to washing out.

Where the surgeon remains in doubt as to the advisability of pylorectomy up to the time that the abdomen is opened, the presence of extensive adhesions between the stomach and adjacent parts, liver, pancreas, &c., the existence of secondary deposits or enlarged glands, the extension of the disease into the omenta—if any of these are present—pylorectomy should be abandoned.

If pylorectomy be decided upon, one of the following methods may be adopted:

i. **Kocher's Method.** ii. **Pylorectomy combined with Gastro-duodenostomy or Gastro-enterostomy.** iii. **Pylorectomy, with direct suture of the divided ends.** iv. **Pylorectomy, the ends being directly united by some such means as Robson's bobbin.**

For some days before the operation the stomach should be washed out with tepid water, syphon-fashion, by an india-rubber tube and funnel, till the contents come out clear, this being done more frequently according to the degree of dilatation of the viscus. Immediately before the operation* the stomach is again washed out with some dilute aseptic solution, as well-diluted salicylic acid, or boro-glyceride (1 in 30), or potassium permanganate. For some time beforehand the patient must be fed with that food which is found to cause least vomiting. In Mr. Southam's case this was found to be peptonised milk and custard. The bowels should be well cleared out with enemata, and every precaution at the time of the operation should be taken against shock—viz., wrapping up the patient well, a hot-water bed, hot bottles, bandaging the limbs in flannel, keeping the head low, the administration of ether if possible, or A.C.E., for the greater part of the operation, and subcutaneous injections of ether and brandy.

(i.) **Kocher's method of combined Pylorectomy and Gastro-duodenostomy.**—The following account is taken from Kocher (*Oper. Surg.*, trans. by Stiles, 1895, p. 134). A central incision, four to six inches long, is carried downwards below the umbilicus for a distance corresponding to the position of the tumour. The umbilicus is excised and all hæmorrhage arrested. The tumour is next drawn out as far as possible, and its limits carefully determined. The omenta are separated above and below over an area corresponding to the amount to be removed. This separation should run as close to the stomach as is consistent with complete removal of the disease, and is effected by the finger or a blunt instrument, all bleeding points being ligatured.

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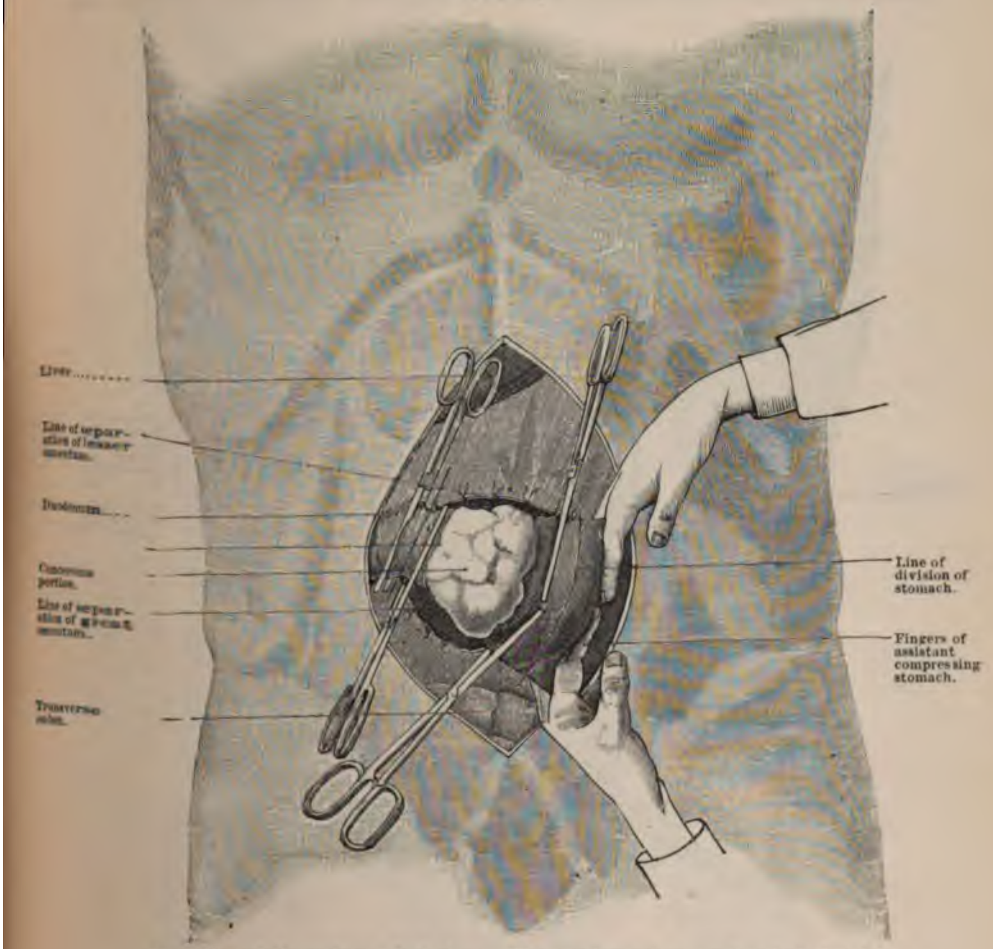
* In Mr. Southam's case the need of this final washing was proved by the fact that a quantity of dark-coloured grumous matter was brought away, which otherwise might have escaped into the peritonæal sac.

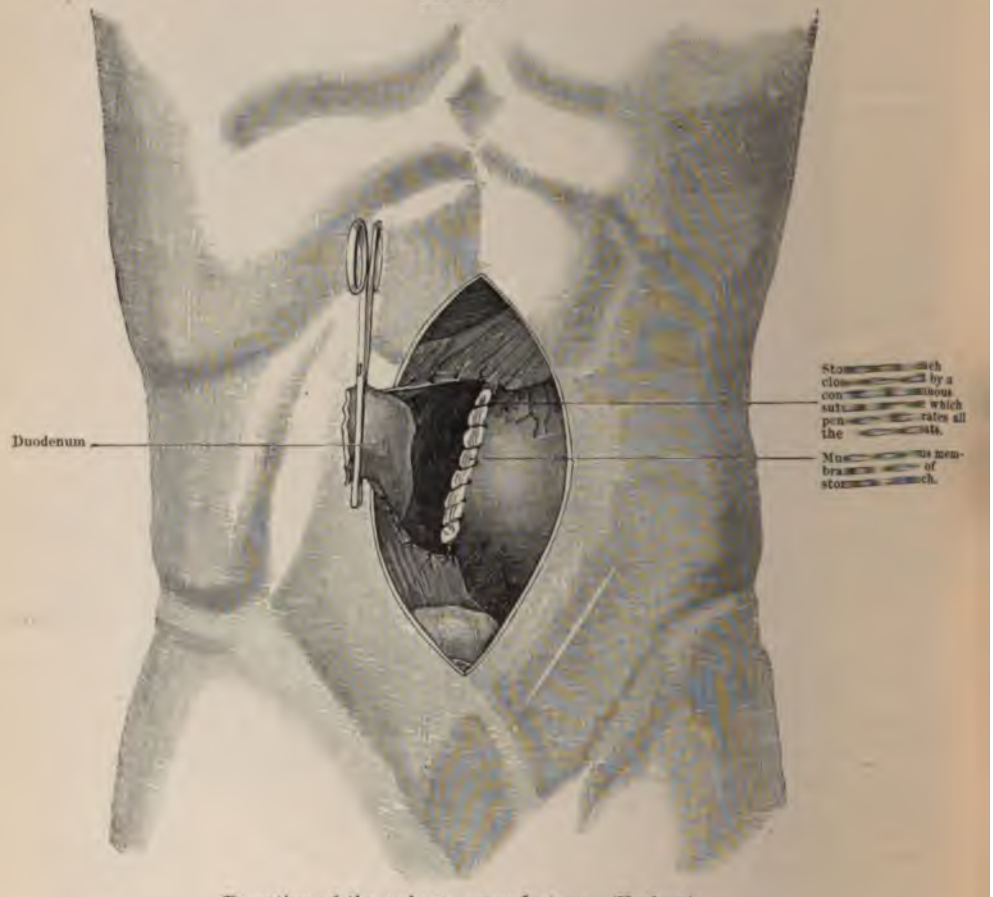
FIG. 125.


Liver
Line of separation of lesser omentum.
Duodenum
Cancerous portion.
Line of separation of great omentum.
Transverse colon.
Line of division of stomach.
Fingers of assistant compressing stomach.

Resection of the pylorus, first stage. The carcinomatous portion is isolated by separating the omenta, and then shutting it off by means of clamps. The cavity of the stomach is shut off by the fingers of an assistant, and that of the duodenum by clamps. The lines of section are indicated by interrupted lines. (Kocher.)

After isolating the tumour, sterilised gauze is passed beneath it and around the duodenum and stomach, so as to prevent their contents reaching the interior of the abdomen. A clamp is now placed upon the duodenum close to the edge of the tumour, and two (these being in line, one from above and the other from below) upon the stomach, well to the gastric side of the tumour (*vide* Fig. 125). The clamps are large artery forceps, closed by the usual catch. They may be closed without hesitation, as there is no danger of causing necrosis of the gastric or intestinal walls. A second clamp is placed upon the healthy duodenum, parallel to and beyond the first, and the intestine is then cut across between them. The edge of the gut which projects beyond the clamp is thoroughly disinfected by means of a small swab soaked in a 1 in 1000 sublimate solution. The divided duodenum towards the side of the growth is merely wrapped round with sterilised gauze and lifted out with the growth; the other end of the duodenum is folded over the right margin of the wound and covered provisionally with moist gauze. The assistant now grasps the stomach from above and below between the forefinger and thumb, or between the index and middle fingers of each hand, in order to close it securely; and after placing a ring of gauze over the hands of the assistant and round the stomach, the surgeon cuts across the latter well to the cardiac side of the two clamps. The new growth is laid aside, and, after any escaped gastric contents have been swabbed up, and the more important bleeding

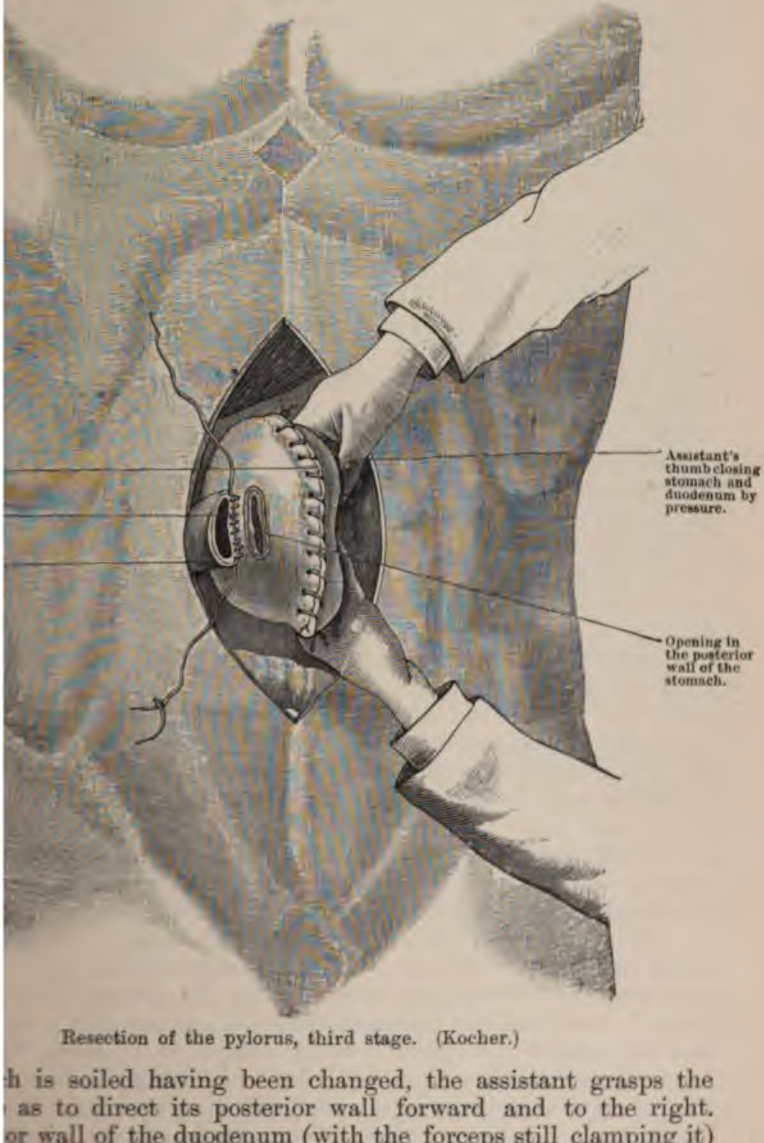
FIG. 126.


Duodenum
Stomach closed by a continuous suture which penetrates all the coats.
Mucous membrane of stomach.

Resection of the pylorus, second stage. (Kocher.)

red, the stomach is closed by a continuous silk suture which *ll three coats* (*vide* Fig. 126). The projecting edges of the mbrane are thoroughly cleansed with sublimate solution. uous deep suture is then invaginated, and a continuous suture carefully applied, so as to keep the serous coats l completely approximated in their whole extent. Any

Fig. 127.


Assistant's thumb closing stomach and duodenum by pressure.
Opening in the posterior wall of the stomach.

Resection of the pylorus, third stage. (Kocher.)

h is soiled having been changed, the assistant grasps the as to direct its posterior wall forward and to the right. or wall of the duodenum (with the forceps still clamping it) lied to the posterior wall of the stomach in such a way *inuous posterior serous suture* may be comfortably introduced and the stomach from the upper to the lower edge of the intestine (*vide* Fig. 127). It is only now that the forceps are removed from the duodenum. The escaping contents are thoroughly removed and the lumen disinfected. Ligatures are applied to any bleeding points. The stomach is next incised about a quarter of an inch from the posterior serous suture for a distance corresponding to the opening in the duodenum.* *Another continuous posterior suture* is next introduced, this one taking up all three coats. The ends of the posterior sutures, which have been left long, are now re-threaded and employed in succession for the *anterior sutures*, the order being reversed. The protecting gauze having been removed, the lines of suture are again thoroughly disinfected, the stomach and intestine replaced, and the wound closed. Instead of uniting the cut end of the duodenum into an opening in the stomach, the surgeon, after a free pylorectomy, might close the end of the duodenum as well as that of the stomach, and then unite the viscera by Halsted's or some other method (p. 269).

Kocher emphasises the following points as essential to success: (1) The operation must be performed *aseptically*, and the greatest care must be taken to avoid the entrance of disinfectants into the abdomen. Sublimate and its substitutes must only be used to disinfect the lines of suture and those areas of peritonæum which have been directly contaminated by the gastro-intestinal contents. Kocher thinks that collapse is often due to the too free use of such disinfectants. Even during a very prolonged operation, salt solution should be employed exclusively for the swabs, and all the gauze placed around the wound. To prevent the entrance of gastro-intestinal contents, it is essential to use plenty of soft gauze. (2) As advocated by Rydygier and Lauenstein, *all the sutures*, the superficial serous, and the deeper which take up the whole thickness of the wall, *must be continuous* and without the least interruption from one end of the wound to the other: this is why Kocher so strongly urges leaving the ends of the posterior sutures long after knotting them, so that they may be again reliably knotted with the anterior sutures. A perfectly secure closure is thus attained, and there is not the slightest necessity to prove that the suture is water-tight, by distending the intestine. Another reason for carrying the continuous suture through the entire thickness of both gastric and intestinal walls is that only by this means can reactionary hæmorrhage, which has been the cause of a certain number of fatal cases, be prevented with certainty. Fine strong silk must be used for the sutures, not the less reliable catgut. Kocher has not seen any of the disadvantages ascribed to silk. He considers that Senn's method is more complicated than his own, and that its results have not quite fulfilled expectations. (3) *The employment of clamps.* Kocher considers these absolutely necessary for the closure of the cancerous portion, both on the duodenal and the gastric side. It is only in this way, as he has pointed out (*Centr. f. Chir.*, 1883, No. 45), that the dangerous escape of cancer juice can be prevented with certainty. The clamps have the following additional advantages—viz., that the intestine, and more especially the stomach, can be cut across along an exact line at the place desired, a matter which is otherwise not always easy. Further, the use of clamps greatly shortens the operation. They produce complete closure, and serve as convenient handles for drawing up and manipulating the parts. They increase the possibility of completely disinfecting the cut edges immediately after the section, by preventing their slipping back. Lauenstein's objection that they necessitate removal of additional sound tissue is hardly a disadvantage, as the prospect of a permanent cure is thereby increased. As to other disadvantages, Kocher is convinced that they cause no necrosis if the operation be properly and aseptically performed. He has no hesitation in applying a clamp to the healthy part of the duodenum where it is afterwards to be stitched.* In his use of clamps, Kocher applies no elastic covering after the manner of Gussenbauer, nor does he use the elastic bands of Rydygier. He merely clamps them firmly enough to thoroughly close the intestine and stomach, and has observed that the edges of both bleed actively as soon as the clamps are removed. Finally, Kocher denies that the clamps, by requiring unnecessary room, necessitate a needless separation of the mesentery as stated by Lauenstein.

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* The intestine is held vertically against the stomach while it is being sutured, and the opening in the stomach is made vertically also.

ii. **Combined Pylorectomy and Gastro-duodenostomy or Gastro-enterostomy.**—This method, the adoption of which is becoming more and more general, bids fair to become the recognised method of performing pylorectomy. The chief advantages are:—(1) Great rapidity and simplicity, especially if the anastomosis be made with a Murphy's button. (2) It is as easy to remove a considerable portion of the stomach as to excise the pylorus only; hence the surgeon need run no risk of not removing the growth widely enough. The primary stages of the operation are similar to those of Kocher's method (p. 316). After the diseased portion of the stomach has been removed, the cut edges of both the divided stomach and duodenum are closed by two rows of silk sutures, the first continuous and including all the coats, the other continuous or interrupted, according to the choice of the operator, inverting the first row and including the serous and muscular coats only.

The second portion of the operation consists in the performance of the gastro-jejunostomy, which is carried out either by direct suture or by means of Murphy's button, as described below (p. 330).

iii. **Pylorectomy, with direct suture of the divided ends.**

Operation.—(Owing to the time this method takes it is not to be recommended. It will be described out of respect to the Continental surgeons who have acted as pioneers in this direction.)

Various *incisions* have been made—viz.: (1) A vertical one in the linea alba, above the umbilicus. (2) A vertical one in the right linea semilunaris, or through the rectus, separating its fibres so as to avoid hæmorrhage (p. 299). (3) Obliquely from above downwards, and from within outwards, between the umbilicus and right ribs. (4) More transversely over the tumour. Either of the last two gives more room, and thus better access to the growth. But as both are accompanied with more hæmorrhage, and are much more difficult to close*—a point which may be of much importance at the close of such an operation—they should not be made use of. Suture of a divided retracted rectus is most embarrassing if there be any distension of the abdomen. All hæmorrhage having been first arrested, the transversalis fascia and peritonæum are pinched up and opened so as to admit two fingers, which examine the growth; and note the presence of adhesions or enlarged glands, invasion of the liver, pancreas, or colon, or curvatures of the stomach itself. If the disease is so localised as to allow the surgeon to go on, the opening in the peritonæum is enlarged so as to get a better view of the disease, and to enable the mass to be drawn forwards with vulsellum-forceps. This having been done as much as possible, the stomach is packed around with hot carbolised towels or sterile gauze, so as to prevent any escape of fluids into the peritonæal sac. The omenta are next separated† with scissors, either between double ligatures of chromic gut previously passed with an aneurysm needle, or between large pairs of omental clamp-forceps; the tissues being very thin it is not necessary to take much time in tying them bit by bit. Any suspicious lymphatic glands must be removed.

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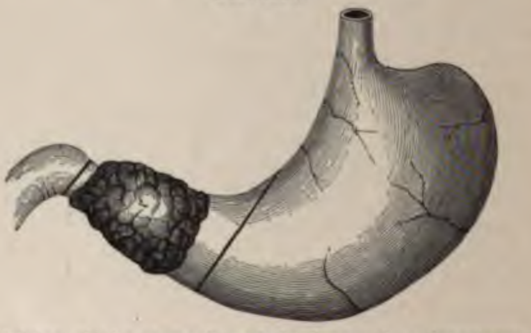
* The closure of the cardiac side of the section of the stomach must be effected merely by the hands of an assistant.

FIG. 128.‡



Oblique division of the stomach and duodenum in pylorectomy. Billroth in this case made half the division of the stomach first, united this with "occlusion sutures," next severed the rest of the stomach, then the duodenum, finally uniting this to the greater curvature. (Billroth.)

Excision of the Diseased Pylorus.—Previous to this, iodoform-gauze tampons should be still more carefully packed around the stomach,§ and the duodenum should be secured, either with some form of clamp (Fig. 125), or by a strip of iodoform-gauze clamped, or held by an assistant's fingers, wide of the disease. The duodenum is then cut through, as in Fig. 128, with scissors, at least half an inch from the disease. This incision, oblique, so as to diminish as far as possible the difference in the openings in the stomach and duodenum, is made with a series of clean, careful snips, any bleeding points being secured at once with Spencer Wells's forceps if few, and with fine chromic gut if numerous. Any fluid which escapes must be mopped up with or caught on aseptic gauze, and a small sponge, fastened to string, may be introduced into either viscus, if it will facilitate the suturing. This step may also be rendered easier by dividing the stomach only partially at first, suturing this part and then completing the division. All the sutures should not be cut short as tied; if the operator leaves some long (clamped in forceps, so as not to be in the way) it may give him a useful hold on the viscera he is uniting. Dr. Adams (*loc. supra cit.*) found that a free removal of the mucous membrane from the edges of the wound greatly facilitated uniting them.

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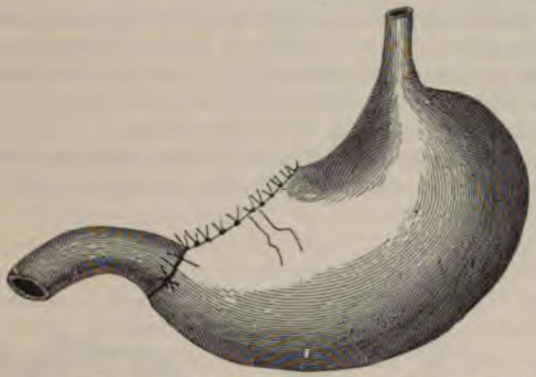
* In Mr. Southam's case, the incision, six inches long, was made two inches above the umbilicus, and across both recti; the contraction of these muscles led to much difficulty in adjusting the abdominal wound.

† Care must be taken only to detach the omenta over the area corresponding to that which is to be removed.

‡ This and the next four figures are taken from Prof. Billroth's *Clinical Surgery*, part iii.

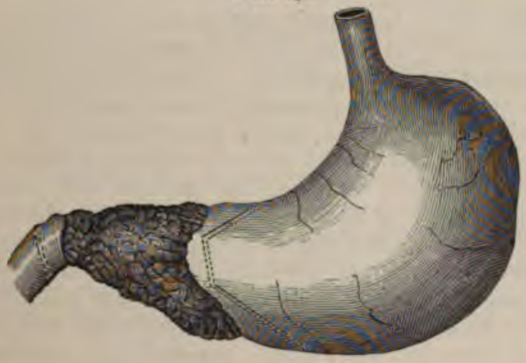
§ It will add greatly to the safety of the operation if the pylorus can be so drawn out of the wound that a flat sponge can be placed within the peritonæal sac, and iodoform gauze packed around the now isolated pylorus.

FIG. 129.



Duodenum united to the greater curvature; ten occlusion sutures unite the upper part of the cut stomach. (Billroth.)

FIG. 130.



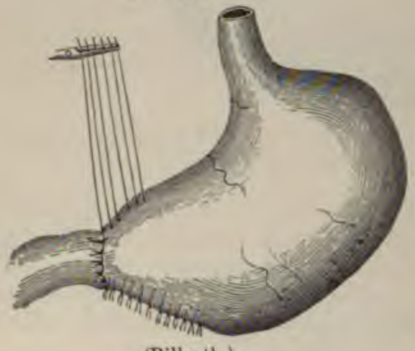
(Billroth.)

The section of the stomach has been made in different ways. The most usual one is shown in Fig. 128. The section is made obliquely.

with the precautions already given in the case of the duodenum. As the cut end of the stomach is so much larger than that of the duodenum, the former must be reduced by suturing part of it before it is completely divided. The surgeon will decide whether he will unite the duodenum to the greater or lesser curvature, or to the part between the two.* In the former case he cuts the stomach from above downwards, and from left to right, and it will be well to unite that part of the stomach which will be superfluous before the section is completed (Fig. 129). The same course is followed if the duodenum is united to the lesser curvature; but here the section is made from below upwards, and from right to left. Figs. 130, 131, show the mode of uniting the duodenum midway between the two curvatures.

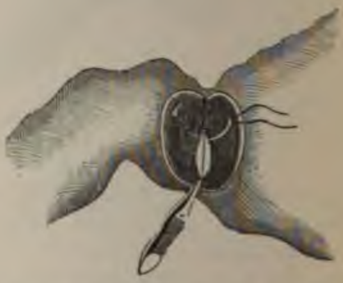
Closure of the Stomach, and Union of this and the Duodenum.—That part of the stomach which is superfluous is closed with carbolised-silk sutures, inserted by Lembert's method, the sutures being left long and held in forceps, so as to steady and move the stomach, and thus facilitate its union with the duodenum. The clamp on the latter being removed, it is united to the greater or lesser curvature, or centre, as follows, beginning with sutures passed from within (Fig. 132). These, of fine carbolised silk, are passed with a needle in a holder, first at the cut edge of the stomach between the mucous and muscular coats, carried on between the muscular and serous, then through the same layers of the duodenum, and finally brought out between these layers and the mucous membrane at the cut edge of the duodenum. When the posterior aspect of the two viscera is thus soundly closed, the anterior one is united by Lembert's suture. The needles employed are fine curved ones for the sutures inserted from within, and round straight ones (No. 5) for the rest. If there is any doubt as to the security of the sutures, an omental graft may be used (Figs. 100, 101, and 102). Dr. Adams employed one of these in his case (*Brit. Med. Journ.*, 1896, vol. i. p. 966), where he employed but one row of catgut sutures.

FIG. 131.



(Billroth.)

FIG. 132.



Insertion of the posterior ring sutures from within. (Billroth.)

Care must be taken, in inserting the sutures, to avoid the formation of any folds (Billroth). The same surgeon says it is well to put a few additional superficial sutures at the point where the borders of the duodenum join those of the stomach. If the stomach contains fluid in spite of the washing out, it must be mopped dry with carbolised sponges kept for this purpose alone, and it may be a help to introduce sponges tied on to silk into the cut ends while the sutures are being inserted, withdrawing them before the stitches are tightened. The sutures being carefully looked over and cut short, a little iodoform is rubbed in, the gauze or towels removed, and the stomach replaced. If any fluids have escaped into the peritonæal sac, this must be carefully cleansed (p. 216). The abdominal wound is then closed in the usual way and the dressings applied.

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* Prof. Billroth prefers uniting the duodenum to the greater curvature.

After-treatment.—This will be conducted on much the same lines as after gastrotomy (p. 311). Mr. Butlin (*loc. supra cit.*) points out that these patients, much let down and exhausted, will not last long on the administration of ice and nutrient enemata only. After the first twenty-four hours, teaspoonfuls of milk, Valentine's meat-juice, raw beef-juice, barley-water, and a few drops of brandy or champagne, should be given, at first every half-hour or hour, and gradually increased up to two pints in the twenty-four hours at the end of a week.

iv. **Pylorectomy, the ends being directly united by some such means as Mayo Robson's bobbin, &c.**—By this means the time consumed by direct suturing is considerably shortened. Dr. Rawdon, of Liverpool, was, I believe, the first in this country thus to improve the technique of pylorectomy (*Brit. Med. Journ.*, 1890, vol. i. p. 323).

After division of the omenta (*vide supra*, p. 322) and resection of the diseased pylorus, the stomach-opening was partially closed by a continuous silk Lembert's suture, commencing at the lesser and stopping one inch from the greater curvature, thus leaving an opening large enough to admit a Senn's plate cut circular. A similar plate was introduced into the duodenum, all four silk threads being passed through the walls a short distance from the cut edges. The case recovered and lived for five years, nearly four of these being passed in perfect health. Three years and eight months after the operation hæmatemesis occurred, followed six months later by dyspepsia and a small swelling under the cicatrix, which steadily increased. At the necropsy nearly the whole of the stomach was occupied by a large ulcer. There were no secondary growths. The close of the case is given (*Lancet*, July 13, 1895) by Dr. W. H. C. Davey, to whom we are also indebted for the account of Dr. Rawdon's operation.

Mayo Robson's bobbin will be an improvement on the above method. Full directions for its use in end-to-end junctions are given at p. 241. But though by the above mechanical means the lengthy process of suturing will be rendered shorter and safer, the difficulty of adjusting securely the larger stomach end to the smaller duodenum still remains, and for these reasons methods i. and ii. are certainly preferable.

GASTRECTOMY.

Removal of the whole or part of the stomach for cancer has now been successfully accomplished a number of times by different surgeons. The operation is indicated when it is found, on abdominal exploration, that the stomach is infiltrated with cancer, but that extensive adhesions and secondary deposits, either in other organs or in the lymphatic glands, are absent. Mayo Robson (*loc. supra cit.*) gives a list of eight cases of complete gastrectomy with four deaths—a mortality of 50 per cent.—and also a list containing fourteen cases of partial gastrectomy, in which at least three-fourths of the stomach were removed. The mortality in these fourteen cases only amounted to 28·5 per cent.

As regards the method of operating, the plan most usually adopted is to remove the diseased area, as described above under pylorectomy (p. 316), and then to perform a gastro-enterostomy by one of the methods described below (p. 328), after completely closing both the divided ends of the stomach. In some cases, however, other methods have been employed. In a very successful case, operated upon by Dr. Harvie, of New York (*Ann. of Surg.*, March 1900, p. 344), the duodenum and œsophagus were united by direct suture.

The patient was a woman, aged 46, who had had gastric symptoms for eighteen months before operation. On examination, a rounded tumour could both be seen and felt. The operation was rendered difficult by adhesions both in front and behind the stomach, practically the whole of which was infiltrated and thickened. The entire stomach was removed, and the cut surfaces of the œsophagus and duodenum united by means of sutures. "The entire time consumed, from the first incision until the abdomen was closed, was one hour and five minutes. There was little or no loss of blood." The subsequent progress was most satisfactory, nourishment being first given by the mouth on the eighth day. The patient left the hospital six weeks after the operation, "after taking a dinner consisting of roast beef, mashed potatoes, ice-cream, cup of coffee, and one glass of milk."

GASTRO-JEJUNOSTOMY.*

The object of this operation is to make an opening between the blocked stomach and the small intestine as high up in the latter as possible, so that the food may still find its way into the intestine and there meet with the other digestive fluids.

Indications.—It may be made use of (A) in malignant disease of the stomach under the two following conditions chiefly: (i) *Together with pylorectomy* or *partial gastrectomy* (p. 325).—This is always to be preferred to an end-to-end union. This combination of operations has given good results (p. 321); it enables us to attempt the removal of the disease, and at the same time greatly shortens the operation.

(ii.) *Alone.*—This is clearly a very inferior operation to those of pylorectomy or pylorectomy and gastro-jejunostomy combined. If all the cases of gastro-jejunostomy which have been performed had been published, it is practically certain that the results both as regards the immediate mortality and the duration of life would be most disappointing. This is no doubt due to the fact that the operation has been far too often performed in very emaciated patients, quite unfit to bear a prolonged operation and to supply the necessary plastic repair. For the future, gastro-enterostomy or, as it should be here more correctly called, gastro-jejunostomy, should be reserved for the following cases of pyloric cancer: (1) Where the malignant disease extends too far into the stomach, or where it is too fixed—*e.g.*, to liver or pancreas—to make either a pylorectomy, or a partial or complete gastrectomy, justifiable; or where secondary deposits and enlarged glands can be felt. (2) Where the cachexia and emaciation* of the patients are not so marked that it is very doubtful whether they will survive an operation that may be prolonged, and which must be severe, in that it necessitates the handling of very vital parts, and for its success entails a certain adequate amount of plastic repair.

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* To be accurate, the term gastro-jejunostomy should be used for union of jejunum to stomach, gastro-duodenostomy for union of duodenum and stomach after a pylorectomy (p. 316). The term gastro-enterostomy, which has been carelessly used for either of the above operations, should be dropped. In future, writers should specify which operation they refer to.

If the operation be carefully reserved for the above cases it will be called for less frequently than of late years, but will be found in these to give great relief. If surgeons continue to perform it, as gastrostomy has been too often performed for malignant disease of the œsophagus, in cases where the operation comes too late, their patients, if they survive, will do so for a very short time, succumbing to the effects of a marasmus so established as to be unalterable. Dr. Murphy, of Chicago, goes further (*Lancet*, 1895, vol. i. p. 1040): "It is my opinion that patients who are not in a condition to stand a pylorectomy† should not be operated upon. The relief obtained, even when gastro-enterostomy is successful, is so limited that it does not justify the danger and discomfort produced by the operation, notwithstanding that the operation can be performed with the button in from five to seven minutes. These patients suffer much more from shock in operation than those with non-malignant disease, and the regenerative power of the tissues with malignant disease is much impaired."

(B) In certain cases of non-malignant pyloric stenosis in which pyloroplasty is not available (*vide supra*), *e.g.*, where there is great hypertrophy of the pylorus, extensive adhesions, or active ulceration.

(C) In chronic ulcer of the stomach when situated near the pylorus, or causing severe hæmorrhage, which cannot be treated by the other means described above (*vide* p. 308). When the patient, owing to severe hæmorrhage, is unfit to undergo a prolonged search for the ulcer, or when the ulcer is adherent and on the posterior wall of the stomach, gastro-jejunostomy should be performed. In the majority of the cases in which this has been done complete relief has followed.

Operation.—The preliminaries are the same as those already given for pylorectomy (p. 316).‡ The abdomen having been opened, the next point is to make sure of finding the jejunum as high up as possible. The omentum and colon having been pushed upwards and to the right, the duodeno-jejunal junction must, if possible, be seen as well as felt where it lies below the pancreas close to the vertebral column; these last two being good landmarks to feel for. This is one of the essential points in the operation. If the piece of small intestine which emerges below the colon be chosen, it may prove to be low down in the ileum. If the wrong end of the small intestine be thus attached to the stomach, the food taken will not be subjected to the natural processes of digestion and absorption and the prolongation of life will be brief. The importance of the above is proved by the fact that the above accident has occurred to operators of such experience as Mr. H. W. Page (*Med.-Chir. Trans.*, vol. lxxii. p. 379). Here the intestine attached to the stomach was the ileum, nine inches from its lower end. This patient lived for ten weeks, and though greatly relieved from vomiting and nausea, began to lose ground at the end of six weeks. Mr. Page quotes some other cases, a striking one being that of Lauenstein (*Cent. f. Chir.*, 1888, p. 472). Here the intestine opened was only fifteen inches from the ileo-cæcal valve. The patient began to have diarrhœa on the fourth day, passed unchanged food in her stools, and died on the eleventh day.

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* Instances which do and which do not justify gastro-jejunostomy would be cases where, on the one hand, the loss has been only two pounds in several months, and, on the other, that of a stone in a week or two.

† By this is meant a pylorectomy shortened by the combined operation with a gastro-duodenostomy (p. 321).

‡ Some Continental surgeons, in order to avoid the risk of after-vomiting, have made use of cocaine only. In an operation like this, of uncertain length, and requiring absolute stillness, general anæsthesia is certainly to be preferred.

The jejunum having been made certain of, high up in its course,* it may be united to the stomach by one of the following methods: (1) **Suturing alone**; (2) **Murphy's button**; (3) **a decalcified bone bobbin**; (4) **Laplace's forceps.** Of the above the first three have been largely tried. Of the different methods of suture alone, I think Halsted's should be preferred, as giving a very large opening with ample margin for contraction and a very efficient suture. Senn's plates simplify the operation greatly; but it is certain from the cases recorded that the opening is liable to contract most seriously later on. Murphy's button has scored very brilliant successes; it is the simplest and quickest of all the methods, and may be resorted to when the patient's condition does not justify any more prolonged method, such as suturing. As I have, however, stated in the account of enterectomy, the very simplicity of this most ingenious instrument has led to its being largely resorted to, and I am of opinion that there are a considerable number of cases in which it has not been successful, and which have never been reported. The decalcified bone bobbin has not yet been sufficiently used in gastro-jejunostomy for a definite opinion to be given; but, judging from its success in operations on the intestine, and its numerous proved advantages, I expect to see it come largely into use here also (*vide* also p. 338).

(1) **Gastro-jejunostomy by Suture alone.** (A) **Halsted's Method.**—This has been figured and described at p. 270. Mr. Bidwell brought a case of gastro-jejunostomy, performed in this way, before the Clinical Society (*Trans.*, 1894, p. 11). The following is taken from his account of the operation:—

> "A portion of the jejunum was held in contact with the anterior wall of the stomach near the cardiac end, both being brought outside the wound and packed around with sponges. Six quilt sutures (Fig. 106) were then passed between the jejunum, half an inch from its mesenteric attachment and the anterior wall of the stomach. No. 8 straw needles had been previously threaded with No. 9 silk, and a separate needle was used with each suture; the ends of each, when passed, were clamped with pressure-forceps. Great care was taken to pick up and include in each suture some fibres of the submucous coat, as strongly recommended by Dr. Halsted. Three sutures were then passed at the end of this row of sutures, and all twelve were then tied and the ends cut short. Six similar sutures were then inserted about five-eighths of an inch in front

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* A sufficient length of the jejunum must be allowed for, so that it can be brought easily round the colon (Fig. 141, p. 336).

of the former row, and each was clamped with forceps. An opening about an inch long* was then made into the jejunum and stomach between the two rows of sutures. Some frothy mucus and blood escaped from the stomach, and the growth, which appeared to completely occlude the pyloric orifice, was easily explored by the finger. A point of suture was used to unite the mucous membranes of stomach and jejunum above and below, and the anterior row of quilt sutures were quickly tied. Some boracic acid solution was allowed to flow over the part while the sutures were being tied. The anastomosis was now complete." The patient had great relief during the five weeks which he survived.

Mr. Bidwell believes that this method of Dr. Halsted's will effect a more satisfactory union than Senn's plates without taking much longer in application. Though he had not used the method before, he was able to effect the anastomosis in twenty-five minutes. He draws attention to the need of turning the loop of jejunum half round after it has been picked up, so that, when it is fixed to the stomach, the axes of peristaltic action correspond in the two viscera.

(B) **Barker's Method.**—While I have stated above why I consider Halsted's method the best, I shall describe an alternative method which has been used successfully. It is that given by Mr. Barker (*Brit. Med. Journ.*, Feb. 13, 1886):—

After pushing the omentum, which was not voluminous, to the left, the first part of the jejunum † was caught in the fingers, and a loop drawn out of the incision. The middle of the anterior surface of the stomach ‡ was also drawn out, and supported all round by warm carbolised sponges. I now passed a piece of india-rubber tubing through the mesentery at each end of the loop, and, having emptied the portion of gut by gentle pressure, drew the ends of the tubing tight enough to prevent access of the contents of the bowel into the loop to be operated on, and fixed each piece of tubing with catch-forceps.§ The empty loop of gut was now laid upon the portion of stomach to be opened, and a longitudinal fold of the latter, about an inch and a half from the great curvature, was pinched up between the finger and thumb of the left hand, together with the collapsed gut. I now made an incision about an inch and a half long in the fold of the stomach, and another corresponding in the approximated fold of gut. These incisions only penetrated through the serous and muscular tunics, and left the mucous coat of both viscera intact for the present.‖ Still holding the parts, as before, between finger and thumb, I now united the corresponding posterior edges of the wounds by a continuous suture, the needle entering and emerging in each case between the mucous and muscular coats, and the threads crossing the cut edges of the muscular and serous coats. In this way the serous surfaces were closely united from end to end before either viscus was opened. This row of stitches (which were about one-eighth of an inch apart) was carried about a quarter of an inch beyond each end of the incision in the coats of the bowel. The moment had now come to open both the stomach and intestine completely, and this was done with a stroke of scissors through the mucous coat in each case, special sponges being ready to receive any fluid which might escape. A few drachms of *succus entericus* flowed from

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* The opening should be much more free, as a rule, for fear of contraction.

† The part actually brought up to the stomach must be about twelve or fifteen inches from its commencement, so as to come up without any tension.

‡ The part of the stomach chosen must always be as far as possible from the disease. And when the stomach walls are thin and atrophied the opening must be as low as possible, as the contents will have to find their way out by gravity alone.

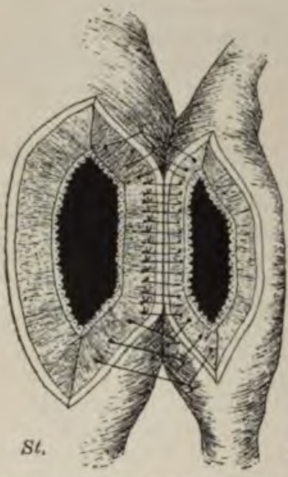
§ If this method be made use of, care must be taken not to puncture any vein in the mesentery, or most troublesome bleeding will follow. Other modes of clamping the intestine will be found at p. 259.

‖ Most troublesome bleeding followed on these incisions, both in the intestine and the stomach, in Mr. Page's case.

> the bowel—little or nothing from the stomach opening. After careful cleansing, the anterior borders of both openings were now united by a row of interrupted fine-silk sutures, introduced according to Czerny's method. When this was completed, the two openings were securely closed, but, as an extra precaution, the intestine was turned over, and the posterior suture was reinforced by a second row of interrupted sutures, placed about a quarter of an inch away from the first. The anterior was then similarly reinforced by a row of continuous sutures taking up, as before, only the serous and muscular tunics. Lest there should be any "kinking" of the latter, as in one of Billroth's cases, I stitched its efferent portion to the stomach wall, about three-quarters of an inch from the right extremity of the opening between the stomach and jejunum."

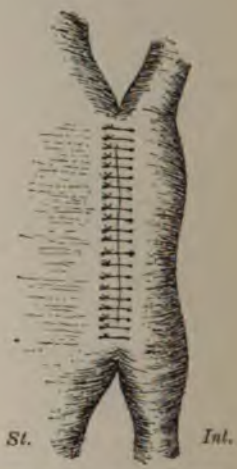
Mr. Page made use of similar steps in his operation to which I have alluded. The following excellent drawings (Figs. 133 and 134) are taken from those accompanying his paper. Some sixty silk sutures were used altogether, a row of Lembert's stitches having been placed around and about half an inch from the closed opening.

FIG. 133.



Gastro-jejunostomy by suture. The posterior edges of the divided stomach and intestine have been united by silk sutures, extending half an inch beyond the openings, at each end. (H. W. Page.)

FIG. 134.



Gastro-jejunostomy by suture. Final union, the anterior lips of the openings in the viscera having been united. (H. W. Page, *Med.-Chir. Trans.*, vol. lxii.)

(2) **Gastro-jejunostomy by Murphy's Button.**—This is the simplest of all the methods of gastro-jejunostomy. As has been the case with this most ingenious instrument after resection of the intestine, it has scored many brilliant successes, but in both cases there is reason to believe that the extreme simplicity of the method has led to its use in many cases which have not been published because unsuccessful. Dr. Murphy in 1895 (*Lancet*, vol. i. p. 104) spoke of there having been twenty-seven cases with nine deaths. Results during recent years have, however, been far superior to this; for instance, Czerny has made use of this method more than a hundred times, without a death attributable to the button, *vide* also the results given on p. 339. In four of the fatal cases in Dr. Murphy's list, death occurred from exhaustion before the

fourth day, and it is stated that in each the approximation was perfect. This date is too early to speak with confidence of the approximation brought about by the button. After remaining perfect for a longer time it may suddenly fail, as in the following case of my own:—

A patient of Dr. Pye-Smith's, at Guy's Hospital, aged 45, was transferred to my care in April 1895, with carcinoma of the pylorus. When the stomach was exposed the growth was too extensive to admit of pylorectomy. It extended for an inch and a half into the pyloric end of the stomach, and sent numerous vascular processes along the lymphatics into both omenta. I united a loop high up in the jejunum to the anterior wall of the stomach, a little to the cardiac side of the centre of the anterior wall so as to be free of the growth. The only difficulty in the operation was making certain of the jejunum. Every step of the union of the viscera was rendered most easy by the button. For seven days the course was uneventful save for obstinate, fixed, gnawing pain which I attributed to the button having to make its way through a thick-walled viscus well supplied with nerves. On the seventh day the bowels acted after an enema. On the eighth this action was repeated, and a small slough was found in the stool. Shortly after, symptoms pointing to perforation occurred, with rapid collapse and death. It is greatly to be regretted that, as the man was one of the paying hospital patients, no necropsy was made.

I have already (p. 238) spoken fully of what I consider to be the dangers of the Murphy button. It is fair to this method to say that the carcinoma was here extensive, vascular, and growing rapidly in a comparatively young patient. It is possible, therefore, that in spite of my precaution I may have placed it in tissues already affected by growth and thus certain to soften prematurely. I did not make use of the v. Hacker position, as preferred by Dr. Murphy, because the anterior or Wölfler method has given very good results, and because, owing to the extension of the growth into the omenta, I was unwilling to disturb the parts more than was absolutely needful. The button should be passed by the fourteenth or twenty-first day. M. Quénu gives the following result of a gastro-enterostomy performed by means of a button. A year after the operation the patient (who had greatly improved) began to fail, and died sixteen months after the operation, jaundiced and emaciated, but without vomiting. The button was found in the stomach, having caused no symptoms. The communication between the viscera was freely open. Recurrence of the carcinoma had involved the pancreatic and bile ducts.

Dr. Murphy (*loc. supra cit.*) gives the following conclusion: (1) That gastro-jejunostomy should never be performed on an extremely cachectic patient. (2) The von Hacker position (p. 336) is preferable, though that of Wölfler may be used. The former favours the passage of the button into the intestine. Out of the cases in which the approximation has been made to the anterior wall of the stomach, the button has dropped back into this viscus in four; in none of them did it give any unpleasant results, and Dr. Murphy believes that it would have passed as soon as the stomach had contracted in size and the patient was up and about. (3) Owing to the poor reparative power of the tissues in these patients, it is well to scarify with a needle the adjacent peritonæal surfaces of stomach and intestine: this hastens the formation of adhesions. (4) A few interrupted supporting sutures between the stomach and intestine, half an inch from the button, may be necessary where there is any tension on the parts. (5) The patient should receive liquid nourishment as soon as the effects of the anæsthetic pass away.

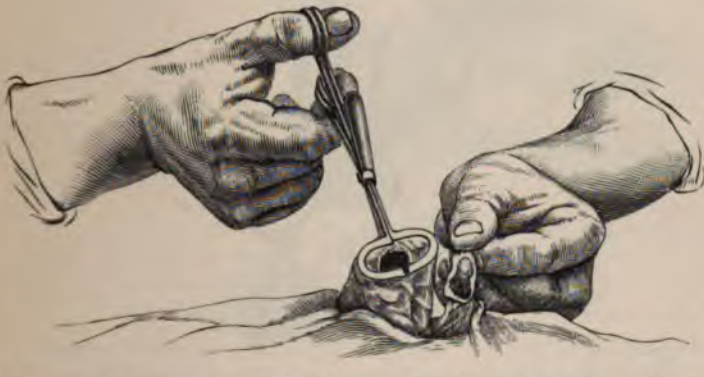
The earlier steps of the operation are as already described. In placing the button in the stomach and jejunum it is advisable, as recommended by Carle and Fontino (*Arch. f. klin. Chir.*, Bd. lvi. Heft 1), to dispense with the purse-string suture, substituting one or two simple sutures at each side of the button after the latter has been forced into the stomach or intestine through as small an incision as possible. This prevents the puckering produced by the purse-string suture, and ensures uniform contact between broad serous surfaces. Kammerer (*Ann. of Surg.*, July 1900, p. 30) adopted this plan in eleven successful cases of posterior gastro-jejunostomy, and speaks strongly in favour of the method.

(3) **Gastro-jejunostomy by means of Decalcified Bone Bobbins.**—This method has been recommended by Mr. Mayo Robson (*Med.-Chir. Trans.*, vol. lxxv. p. 419, and *Brit. Med. Journ.*, vol. i. 1900, p. 628). I have already, at p. 241, spoken of the advantages which Mr. Mayo Robson's method possesses, especially its simplicity, the fact that it leaves only a temporary foreign body in the alimentary canal, and the adaptability of this method to so many operations. From the success which the bobbin has met with elsewhere, it is probable that two other conditions needful for a good result—viz., security against leakage, which is given by the double continuous suture, and the avoidance of after-closure by securing a continuity of mucous surfaces around the new channel—will be gained here also, and I am of opinion that in future the bobbin deserves an extended trial in gastro-jejunostomy.

Operation.—The chosen portions of the stomach and intestine are drawn well up into the wound, emptied, and held in position by forceps which act as guides to the spots to be opened. The peritonæal sac having been thoroughly shut off with sterile gauze, two continuous sutures, one sero-serous and securing peritonæal apposition for fully one-third of an inch from the opening all round; the other, marginal and muco-mucous, when drawn tight, firmly applies the edges of the openings in the stomach and jejunum to the tube, thus preventing any extravasation. The sero-serous, on a curved needle, is first inserted, half or one-third of an inch from the spot where the viscera are to be opened, first to jejunum and stomach alternately, the suture taking up peritonæum and outer muscular coat only. This suture is left long at the end where it begins, and when the extreme opposite end is reached it is not unthreaded, in order to complete the suturing after the bobbin has been inserted, and the marginal or muco-mucous suture completed. The viscera are then opened, the openings being just sufficient to admit the bobbin, but before its insertion the marginal suture, which may be either of chromicised gut or of silk stained with aniline, is applied from right to left, uniting the posterior margins of the two visceral openings, the suture including mucous membrane, and being left long on the right and kept threaded on the left. The bobbin is next inserted, and the marginal suture then proceeded with round the front until the tail of the suture is reached: the two ends are then tightened, tied and cut short, thus uniting the mucous surfaces round the tube. The serous suture is then proceeded with half or a third of an inch from the marginal one until the circuit is completed, when the two ends are tightened, tied and cut short. When the anastomosis is complete, the sutures cannot be seen (M. Robson).

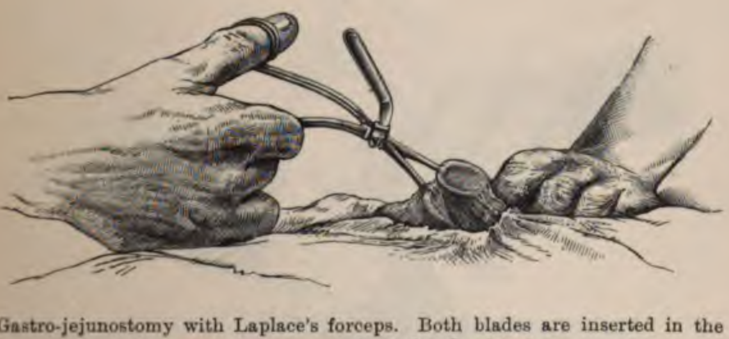
(4) **Gastro-jejunostomy by means of Laplace's Forceps.**—This instrument, already described (p. 249), is used in the following manner for the performance of gastro-jejunostomy. Although the forceps are undoubtedly a great assistance in holding the parts and placing the sutures, it cannot be said at the present time whether, as regards efficiency, this method can be compared with the three well-tried ones which have already been described. The only objection which suggests itself is that as the edges of the mucous membrane are not directly united, subsequent contraction of the opening seems somewhat probable; whether this will occur, experience alone can show. The instrument is so ingenious, however, that at all events it merits a fair trial.

FIG. 135.



Gastro-jejunostomy with Laplace's forceps. One blade of the forceps has been inserted into the stomach. (Laplace.)

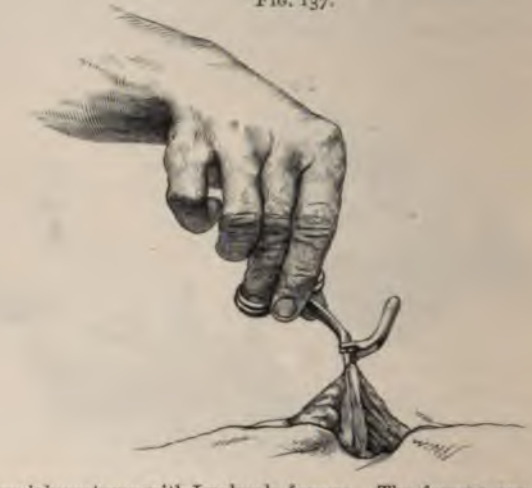
FIG. 136.



Gastro-jejunostomy with Laplace's forceps. Both blades are inserted in the parts to be approximated. (Laplace.)

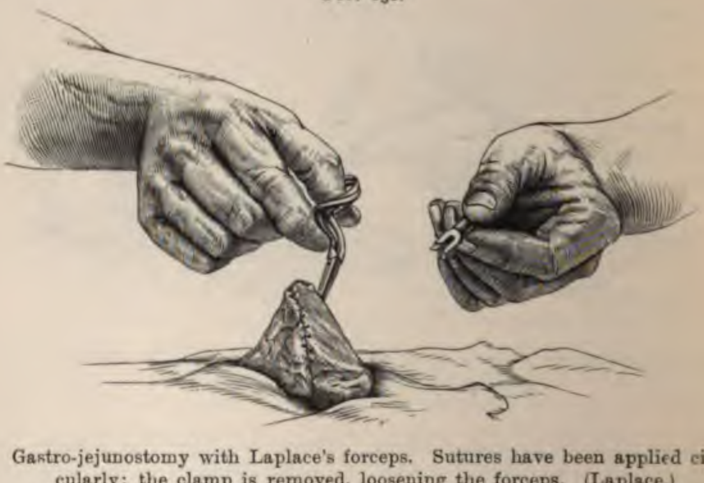
Operation.—The parts to be united having been isolated and brought into apposition, "an incision is made in each part to be anastomosed, about the length of the diameter of the rings to be used." The two blades of the forceps are now introduced through the openings, one blade into the stomach and the other into the intestine (Figs. 135 a 136). The forceps are now closed and clamped, thus bringing in contact the serous coats of the two viscera (Fig. 137), and sutures a introduced "except, of course, at the small place where the instrume penetrates the stomach and the gut." Continuous sutures are used the illustration, but any suture may be employed. "The handles a made to raise the parts up, and afford support as well as a broad surfa to work on. Having united the stomach and intestine, as far as desired, the forceps are easily loosened by removing the clasp (Fig. 13 The forceps constituting one half of the ring is now loosened, and dra out with a semicircular motion (Fig. 139), then the other is removed

FIG. 137.



Gastro-jejunostomy with Laplace's forceps. The forceps are closed and clamped, approximating the serous membrane of stomach to intestine. (Laplace.)

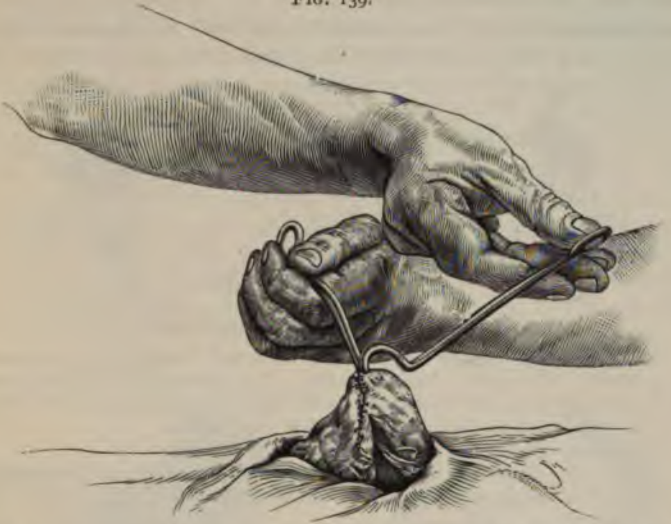
FIG. 138.



Gastro-jejunostomy with Laplace's forceps. Sutures have been applied circularly; the clamp is removed, loosening the forceps. (Laplace.)

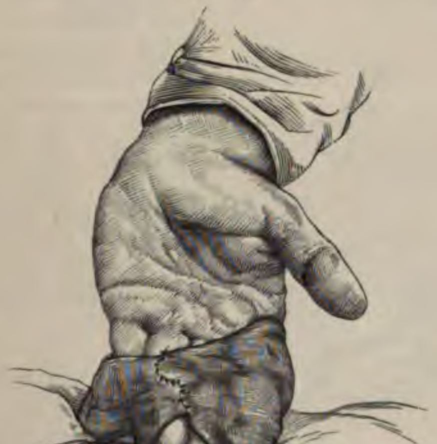
same way (Fig. 139). Finally, one or two more stitches are applied close the opening through which the forceps were removed."

FIG. 139.



Gastro-jejunostomy with Laplace's forceps. One half of the forceps is unclamped; its grasp upon the tissues is loosened, and it is removed by a semicircular motion through the small unsutured aperture. (Laplace.)

FIG. 140.



Gastro-jejunostomy with Laplace's forceps. The operation is completed. (Laplace.)

In describing the chief methods of gastro-jejunostomy I have confined
self to the anterior method of union and to the less complicated pro-
lures by which this union is attempted. In order to facilitate the

passage of food into the intestines and to prevent the regurgitation of intestinal contents—*e.g.*, bile, pancreatic juice, and fæcal fluids—into the stomach, certain modifications of the anterior and simpler gastro-jejunostomy have been introduced.

Von Hacker's and Courvoisier's method of Gastro-jejunostomy (Figs. 141, 143 and 144).—Here the small intestine is joined by suture to the posterior wall of the stomach. The stomach and omentum having been pushed upwards, a piece of intestine high up in the jejunum is made use of as before, emptied, and kept so either by clamps or by a ligature of drainage-tube tied round it, and lightly clamped with a pair of Spencer Wells's forceps. With a blunt instrument, an opening is torn through the transverse mesocolon at a spot where there are no vessels, the edges of this opening are then united by a few points of suture to the hinder wall of the stomach, and then the loop of jejunum fixed by sutures in this gap to the hinder wall of the stomach also. The transverse colon with the great omentum occupy afterwards their normal position in front of the small intestine.

Fig. 141.

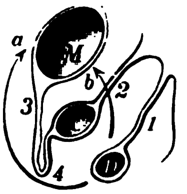


Fig. 142.

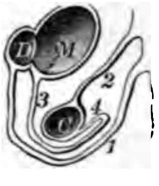
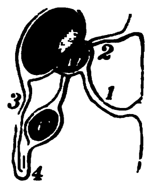


Fig. 143.



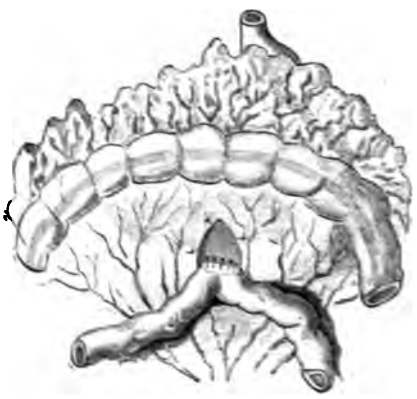
Gastro-jejunostomy shown diagrammatically.

Fig. 141.—M, Stomach. C, Colon. D, Small intestine. 1, Mesentery. 2, Mesocolon. 3 and 4, Great omentum. The parts are here shown in their natural relations. The arrow *a* shows the anterior operation after the method of Wölfler; that marked *b*, the method of von Hacker.

Fig. 142.—Gastro-jejunostomy according to Wölfler.

Fig 143.—The method of von Hacker. The numbers and letters have the same meaning as before. (Von Esmarch and Kowalzig.)

Fig. 144.



Gastro-jejunostomy by the method of von Hacker. (Von Esmarch and Kowalzig.)

For this method the following **advantages** are claimed: (1) It facilitates drainage of the dilated stomach, thus tending to diminish flatulence and dyspepsia; (2) It diminishes the risk of regurgitation of fluids from the intestine into the stomach; (3) This method, by joining the intestine to the stomach through an opening in the transverse mesocolon,* and so below the transverse colon, avoids the risk of strangulation of the large intestine, or at all events the occurrence of tympanites which may arise from its compression.

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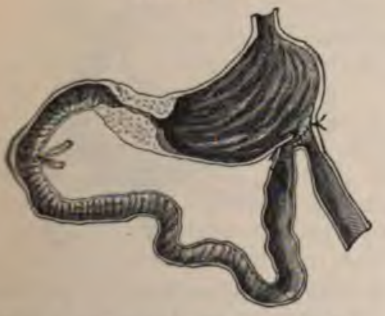
* The feebleness of the small intestine and the fact that it has been strangled in apertures in the omentum and in the foramen of Winslow must here be remembered.

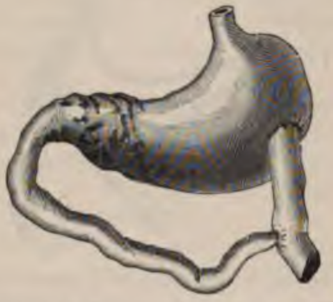
Wölfler's and Kocher's Modifications of Gastro-jejunostomy.—**Wölfler** drew attention to the fact that the long axis of the jejunum must be applied to that of the stomach in such a way as to secure the direction of the onward flow of the contents of the two viscera corresponding—*i.e.*, that the proximal portion of the jejunum be to the left and the distal to the right. Not satisfied with this, he went farther, and in order to prevent any entrance of the contents of the intestine into the stomach, he tried to form a valve-flap over the afferent end of the knuckle of intestine (Fig. 145). Thus, while he stitched the afferent half of the opening in the intestine to the coats of the stomach, where still intact, he united the efferent half only to the edges of the opening in the stomach. The same authority maintained that the same object could be obtained in the following way (Fig. 146). The knuckle of jejunum is cut quite through, the lower end is united to the opening in the stomach, while the upper end is sutured into the intestine lower down (Fig. 146). This, if successful, will ensure the bile, pancreatic juice and other contents of the intestine being delivered into the intestine and not the stomach. But it will be seen that this is secured at great risks, by a complicated operation involving multiple and prolonged suturing, and the need of most careful adjustment of the mesentery at two points.

FIG. 145.



Gastro-jejunostomy by Wölfler's method. (Von Esmarch and Kowalzig.)

FIG. 146.



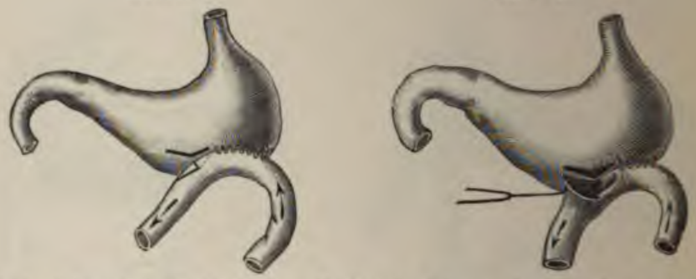
Gastro-jejunostomy by another method of Wölfler's. (Von Esmarch and Kowalzig.)

Kocher having noticed fatal cases occurring after successful suturing and without peritonitis, a fact only to be attributed to the absorption of intestinal contents which have reached and undergone decomposition in the stomach, unites the intestine not with the two long axes corresponding, but with that of the intestine at a right angle to that of the stomach, and in such a way that the proximal fact of the loop ascends, and the distal descends. To still further ensure that the contents of the stomach and those of the proximal part of the intestine should pass out into the distal portion without any regurgitation, Kocher makes a valve by raising a flap from the convexity of the knuckle of the jejunum at a little distance from the stomach, a curved incision being made instead of the usual longitudinal one (Figs. 147, 148). The contiguous serous surfaces of stomach and jejunum having been first united, the outer surface of the base of the flap is next united to the lower edge of the opening in the stomach, the edge of the flap itself being left free. The upper edge of the opening in the stomach is next secured to the lower and concave edge of the opening in the jejunum (Fig. 148).

After-treatment.—It is certain that surgeons have been over-anxious with regard to commencing to feed their patients after this operation. After careful suturing, or indeed after any of the methods of gastro-jejunostomy, feeding by the mouth should be carefully begun within a few hours of the operation. Such liquids as peptones, Valentine's meat juice, raw meat juice, champagne, veal tea, brandy and water, may be given in teaspoonfuls every half-hour at first and soon increased up to half-ounces every hour.

Sequelæ of Gastro-jejunostomy.—(i) **In the cases which recover.** (1) In many great relief is given for a varying number of months from pain, vomiting, dyspepsia, &c., while a gain of flesh is made and maintained. (2) In many others the relief is much more short-lived; the patient, after a short period of relief, though the appetite is voracious, makes no flesh, and quickly goes downhill again. (3) In several cases fœtid vomiting has set in soon after the operation, sometimes entirely spoiling the result.

FIG. 147. FIG. 148.



Gastro-jejunostomy by Kocher's method. The jejunum has first been so united to the stomach as to prevent kinking. The intestine should have been placed with its long axis at a right angle to that of the stomach. (Von Esmarch and Kowalzig.)

(ii) **In cases ending fatally.**—The causes which are active here have been sufficiently indicated in the preceding pages—viz., shock, persistent vomiting, peritonitis (whether due to sepsis introduced at the time of the operation, or to leakage later on, brought about by some fault in the technique), and recurrent hæmorrhage from some of the vessels not being secured by ligature or by the sutures.

Choice of Method.—So conflicting is the evidence on this point that it cannot be said at the present time which is the best method to employ. Persistent vomiting leading to death from inanition is a not uncommon sequel to the operation, and it is to avoid this that the various modifications of the operation have been suggested. The vomiting is commonly due to one of two causes—either that regurgitation takes place from the distal loop into the stomach, or that the opening into the distal loop becomes closed owing to spur formation or kinking. Of these the latter is clearly the more serious, since it is necessarily fatal. Chlumsky (*Ann. of Surg.*, vol. ii. 1898, p. 285) says that this was the cause of death in the majority of the fatal cases in the Breslau clinic, and described having found the distal loop completely collapsed and empty at necropsies.

With regard, first, to the question of regurgitation, the claim of Von Hacker that the posterior operation prevents this cannot be said to have been proved, although published results tend to show that vomiting from regurgitation is less frequent after this method, and certainly, while the patient is in the recumbent position, the opening is more favourable. On the other hand, the greater difficulty of this method must to some extent discount the advantage gained. Regurgitation can doubtless be prevented by some of the more complicated proceedings recently introduced—such, for instance, as Wölfler's second method (*vide* Fig. 146); but here again the severity of the operation is a great disadvantage. With regard to the best method of preventing spur formation and blocking of the distal loop many operators are in favour of Murphy's button. For instance, Chlumsky (*loc. supra cit.*) says "the opening is ideal in its working." Kammerer (*loc. supra cit.*) is of the same opinion, having had eleven cases, with a satisfactory opening in all of them, also quoting Carle as having operated upon twenty-three cases without a single death, and Czerny as having reduced his mortality 20 per cent. by the use of Murphy's button.

On the other hand, Mayo Robson, Barker, and others have expressed contrary opinions, and prefer either bobbins or suture. If Murphy's button is used it would seem, on the whole, preferable to perform the posterior operation, because the button will be then more likely to pass into the intestine than to drop back into the stomach.

In support of this it may be stated that, as far as can be judged, the results of this plan—viz., posterior gastro-jejunostomy with Murphy's button—have been as good as any other method.

GASTROPLICATION.

This operation, which was first performed by Bircher in 1891, has for its object the reduction of the size of a dilated stomach. This is accomplished by making one or more longitudinal folds or tucks in the wall of the stomach by means of sutures. The operation has been performed a number of times. Mayo Robson (*Lancet*, March 24, 1900, p. 831) gives a list of twenty-eight cases, with two deaths. In one of the fatal cases, however, death was due to syncope two weeks after operation, so cannot be ascribed to the operation.

Some of these operations were performed in cases in which definite pyloric stenosis was the cause of the dilated stomach. It is clear that such a proceeding cannot be of any value unless the pyloric stenosis is relieved at the same time by pyloroplasty or gastro-jejunostomy, and even then the propriety of gastroplication is doubtful, since there is a good deal of evidence to show that a dilated stomach quickly recovers its normal size after removal of the cause.

The application of gastroplication therefore should be limited to those very rare cases of idiopathic dilatation of the stomach. Even in these question of gastro-jejunostomy should be considered, for, as

Farquhar Curtis (*Ann. of Surg.*, July, 1900, p. 49) says, "If the surgeon should chance to overlook some cause of pyloric obstruction his patient will be sure of a cure if he survives the operation, whereas gastroplication will be useless if pyloric obstruction exists."

DUODENOSTOMY.

This and the following operation have been proposed, in cases unsuited for pylorectomy, as a means of getting nourishment into the alimentary canal below the disease, and thus giving rest to the diseased parts, especially in those cases of infiltration of the whole of the stomach, rendering gastro-jejunostomy impracticable. But little favour has been accorded to either of these operations, and both are destined to be dropped. Duodenostomy especially has the serious objections that it deals with a fixed portion of intestine, one difficult to deal with, and one into which important fluids are poured, which thus may readily escape from a fistula made here. Furthermore, all the cases have, I believe, been fatal.

JEJUNOSTOMY.

This operation has the serious disadvantage of being liable to leakage at a point high up in the alimentary canal, where the fluids traversing the bowel are of the greatest importance from a nutritive point of view. Thus it has followed in the majority of cases that no great prolongation of life has resulted from this operation. Dr. Hahn (*Deut. Med. Woch.*, 1894) gives a list of five cases of jejunostomy. One, a case of gastric carcinoma, died in a fortnight; another, a case of œsophagal carcinoma, died in four days; the third, a girl aged 23, who five weeks before had drunk sulphuric acid, died on the eighth day. Mr. Jessett (*Dis. of the Stomach and Intestines*, p. 64) relates two cases operated on for œsophageal carcinoma. One survived nine months, when extension of the disease proved fatal. The other only survived seven weeks. Mr. Golding Bird brought a case before the Clinical Society (*Trans.*, vol. xix. p. 70); here the operation was performed for advanced carcinoma of the pylorus. The patient was making a good recovery up to the ninth day, when fatal peritonitis occurred owing to an accident in the feeding.

Indications.—(1) Cases of carcinoma of the pylorus and stomach where other operations are impossible. (2) Cases of carcinoma of the cardiac end of the stomach and œsophagus when gastrostomy is out of the question.

Operation.—This is performed with strict aseptic precautions and in two stages. The abdomen having been opened, the jejunum is made certain of at a point high up in its course with the aid of the directions given at p. 327. A knuckle being drawn into the lower part of the wound, the upper two-thirds of this are united, the bowel is fixed most carefully to the edges of the wound, very much as in gastrostomy (p. 302). The intestine should be opened on the third day by a small puncture. Later on, when all is firm, the patient will be able to feed himself by a funnel and tubing. If it is absolutely needful to open

:, the surgeon may try to make an oblique opening after the f Witzel (p. 300). Mr. Golding Bird found that a meal of twenty ounces every four hours, the catheter being directed always caused symptoms due to over-distension of the small and that a better plan was to give a meal of ten ounces, half en towards the duodenum and half towards the ileum.

CHAPTER VIII.

EXCISION OF THE SPLEEN.

Indications.—All of these are rare, and many of them are still doubtful.

1. *Cystic Spleen.*—When this is found to be unsuited for drainage. Mr. K. Thornton's case of this kind was the first successful splenectomy in England.

2. *Injury.*—This has been already alluded to when gunshot injuries of the abdomen were considered (p. 285). Other cases in which it may be called for are, prolapse of a spleen, injured or not, through a wound, rupture of the spleen, and stabs of this viscus. Hitherto surgeons have often been deterred from attempting to remove a ruptured spleen by the frequency with which this injury is complicated by injury to other abdominal or thoracic organs, especially the liver itself. From the shock of these the patient never rallies sufficiently to justify exploration. Fresh interest will be called to this matter by three successful cases of splenectomy for rupture of the spleen brought by Messrs. Ballance and Pitts before the Clinical Society (*Lancet*, vol. i. 1896, p. 484).

In the first case, under Mr. Ballance, a boy, aged 10, had been struck five days before his admission into St. Thomas's Hospital by a "full-pitched ball" on the left side. Severe pain followed, but passed off until a few hours before admission. At this time severe shock was present from which the patient rallied slightly. The spleen was removed through a four-inch incision in the left linea semilunaris.[*] It was noticed that a speniculus was left behind. The boy recovered rapidly, and was in robust health five months later, but the superficial glands had enlarged.

In the second case, also under Mr. Ballance, the patient, a woman, aged 45, had been run over by a hansom cab. Shock was so marked a feature that operation was not justified until the next day. Though the patient left the theatre in a desperate condition, in ten days she was apparently convalescent. Then she began to go downhill, and by the eighteenth day her condition was again critical, with weakness, emaciation, thirst, drowsiness, &c. The administration of extract of sheep's spleen and raw bone marrow daily restored her gradually to convalescence and ultimately to complete recovery. Some groups of external lymphatic glands could be felt in this case.

In the third case, under the care of Mr. Pitts, a man, aged 36, had fallen on an iron girder, striking his left side. He complained of pain there, but was otherwise pparently well. About four hours later he became suddenly collapsed. Four hours fterwards he had responded sufficiently to restoratives to make operation justifiable. This patient, when apparently convalescent, began to lose ground in a similar way o the second patient. Cod-liver oil and bone marrow were given, but it was not till rsenic was administered that any real improvement was observed. He ultimately gained robust health, but all the superficial lymphatic glands could be felt enlarged.

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[*] In one at least of these three cases the spleen appears to have been removed by a median incision. This would have the advantage of allowing the operator to investigate the state of the liver and kidneys.

In each of these cases the spleen was not only ruptured, in the third completely across, but the vessels in the hilum were torn across also. The authors remarked that where this was not present a rupture of moderate severity might perhaps be treated by suture. As to the diagnosis of ruptured spleen these brilliant successes point to the value of the following: (*a*) The locality of the injury; (*b*) the evidence of internal hæmorrhage; (*c*) the great increase of fixed splenic dulness; (*d*) the evidence of an increasing collection of fluid in the abdomen, and of the fact that while the dulness in the right flank can be made to disappear by change of position, that in the left flank remains constant. The operation should not be performed until the patient has sufficiently reacted from the stage of collapse, and it should take place before that of suppurating clots and a toxic state of the patient has supervened. In the case of the spleen where an escape of blood alone follows on the rupture, the last mentioned most grave condition will not follow so quickly as in the case of the kidney. The peritonæal sac should be cleaned as thoroughly as possible from all blood and clots. Every precaution for meeting shock should be taken before and after the operation.

3. *Movable or Wandering Spleen.*—When this condition causes troubles, analogous to those of movable kidney, not relieved by a belt.

Dr. McGraw (*Med. Rec.*, vol. xxxiii. No. 26) removed an enlarged and dislocated spleen, which formed a tumour in the right iliac fossa, and partially displaced the uterus and bladder. A week later pain in the left shoulder and left-sided pleuro-pneumonia supervened. Nine months afterwards the ligature was coughed up. Recovery followed.

Operation is far more satisfactory here than in most other morbid conditions of the spleen, as shown by the statistics of the last decade which are given by Collins Warren (*Ann. of Surg.*, vol. i. 1901, p. 521.) During this period forty-three cases of extirpation of wandering spleen have been recorded with only three deaths.

4. *Malignant Disease.*—Primary sarcomatous or carcinomatous disease of the spleen is extremely rare. Up to the year 1890, five cases of splenectomy for sarcoma were reported by Hagen, of which three recovered and two died. From 1891-1900 Warren reports five further cases, including one of his own, of which four recovered and one died.

5. *Splenic Anæmia.*—This condition must be carefully distinguished from splenic leukæmia. The latter is associated with marked leucocytosis, which is not the case in splenic anæmia. The chief symptoms are splenic hypertrophy, gradually increasing anæmia, and a tendency to hæmorrhages. Collins Warren describes a case in which the disease was cured after removal of the spleen, and also mentions seven cases reported by Sippy, five of which recovered after splenectomy

6. *Malarial Spleen.*—With regard to the question of operation for this condition Collins Warren says: "Quite a number of malarial spleens have been removed in recent years, and the mortality per cent. of the operation

is still diminishing. Hagen has collected eighty-eight cases of malarial hypertrophy of the spleen, exclusive of wandering spleen. Of these cases, twenty-four previous to the year 1890 gave a mortality of 62·5 per cent., while sixty-four cases operated after the year 1890 gave a mortality of 23·4 per cent. When we consider the very large size that the organ often attains in this disease, and the unfavourable constitutional condition of the patient, such results, if not all that we could hope for are at least encouraging."

7. *Leukæmia.*—This operation has been so invariably fatal that it ought to be abandoned.*

Operation.—The preliminary steps will be directed to ensure asepsis and to diminish shock. The incision has usually been one in the linea alba. The advantages of this in the case of ruptured spleen have been given above. For other cases, that in the linea semilunaris, or one further out (Bryant), from the left anterior superior spine to the ribs, would probably give better command over the pedicle. Additional room may be gained by division of the left rectus. All hæmorrhage having been stopped, the peritonæum is opened freely and the hand explores the tumour. If at this stage the surgeon is satisfied that the adhesions between the spleen and the diaphragm are extensive and intimate he will do well to close his wound. If, however, it is decided to proceed, any adhesions, as of the overlying omentum, are separated, between ligatures if needful. Where the adhesions are very broad, interlocking chain-ligatures must be employed. In a very few cases the use of the thermo-cautery may be justified. Any adhesions with the pancreas are very difficult to deal with. Esmarch and Kowalzig advise removal of a portion of this viscus. The spleen is next brought out of the wound, the lower extremity first, and sterile gauze is carefully packed around it. This extraction of the viscus must be carried on with the utmost caution and gentleness, as its friability may easily lead to a tear and most profuse oozing, and as dragging on the pedicle may easily induce collapse, and is also likely to lead to some small vessel retracting from the ligatures as they are applied, and causing fatal hæmorrhage.

The spleen being wholly outside the body, the most important part of the operation, securing the pedicle, remains. Collins Warren finds that the remainder of the operation is greatly facilitated if the spleen is at this stage rotated forwards so that the posterior surface of the organ is in front. A better view of the pedicle is thus obtained without stretching, and the application of ligatures is therefore rendered easier. The pedicle, if present,† must now be carefully examined. If the patient's condition is good, the safest plan will be to secure the vessels as far as possible separately, the pedicle being divided, as the late Mr. Greig Smith suggested, piecemeal between pressure-forceps; where there is not time for this, it will be wiser to secure the vessels in two or three portions, transfixing in two places, and inter-locking the ligatures (Thornton). Carbolised silk should be used, fairly stout, and not tied so tightly that it will cut its way through too quickly. However the pedicle is treated, the following precautions should be followed: (1) To prevent any tension being exerted on the pedicle (*vide supra*). (2) To secure every vessel. (3) To divide these, in a relaxed condition, at a sufficient distance from the ligatures. (4) Not to include the tail of the pancreas. (5) After all the ligatures have been applied, it may be well for sake of safety to throw one round the whole. (6) Not to twist the spleen round at all in dealing with the pedicle.* In some cases where secondary hæmorrhage is feared, the pedicle should be kept outside. Again, when oozing from adhesions is very likely to take place, especially when a large gap is left by the removal of a huge spleen, plugging with iodoform gauze after the method of Mickulicz will be advisable (p. 218).

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* The late Mr. Greig Smith gave eighteen cases; Mr. Thornton, thirteen; Mr. Collier, sixteen—all fatal. The only case which has recovered—Franzolini's of Turin (*Wien. Med. Woch.*, 1883, No. 20)—is considered one of hypertrophy by Thornton, Collier, and Crédé.

† In a case of Mr. L. Browne's (*Lancet*, vol. ii. 1877, p. 310) there was no pedicle as such, four very large arteries being met with and secured with double ligatures.

The abdominal sac is next cleansed and the operation completed as after ovariotomy. The after-treatment is also much the same.

Causes of Death.—By far the most frequent is hæmorrhage. This may be from the omentum adherent over the spleen, from the large vessels to this viscus, from some small vessel which has retracted, from the splenic vein, or from sponge-like adhesions (Bryant).

Mr. Hatch, of Bombay (*Lancet*, 1889, vol. ii. p. 1053), met with a case in which death took place a few hours after the splenectomy, owing to oozing from some adhesions between the spleen and the diaphragm, which had required separation.† The pedicle was safely secured. In another case (*Centr. f. Chir.*, July 18, 1885), death, twenty-four hours after the operation, was due to bleeding from the abdominal incision, owing to the defective coagulation of leukæmic blood. The ligature on the pedicle was firm.

The after-treatment of post-operative anæmia, &c., is given at p. 342.

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* Sir S. Wells (*Med. Times and Gaz.*, Jan. 6, 1866, p. 4) draws attention to this. Having done so in order to bring the vessels into a cord, the splenic vein was ruptured.

† See also G. A. Wright's case (*Med. Chron.*, Dec. 1888). This surgeon suggests the use of a long, sharply-curved tenaculum for stopping bleeding from a deeply-seated vessel in the back of the abdomen.

CHAPTER IX.

OPERATIONS ON THE LIVER AND BILIARY TRACTS.

OPERATIONS ON THE LIVER.

HYDATIDS.—HEPATIC ABSCESS.—REMOVAL OF GROWTHS OF THE LIVER.

OPERATIONS FOR HYDATIDS.

THIS will include different forms of puncture, free incision, electrolysis, and enucleation. The milder measures of puncture and electrolysis have proved successful in many cases, but we do not know for certain how the death of the parasite is brought about by them in successful cases, and they are largely uncertain.

A. **Puncture.**—While incision is the only certain and reliable mode of cure, it is worth while to try the different forms of puncture, especially in certain cases, for instance when the patient refuses severer methods.

There is no need to do more than to describe briefly such an operation as this, and to tabulate the chief practical points.

The parts being cleansed, and an anæsthetic * given if the patient is very nervous, the surgeon chooses a spot for puncture at a most prominent part of the tumour, satisfying himself as to dulness.† If the skin is thick he makes a minute puncture with a scalpel and sends in a fine trocar or aspirator needle. The quantity withdrawn must vary with the case, the size of the cyst, the timidity of the patient, &c. From six to sixty ounces are instances of small and large quantities. The aspirator should, on the whole, be preferred, as likely to remove more fluid, and thus, probably, more likely to produce a cure, but as the exhaustion is more likely to plug the cannula, a fine wire must be in readiness.

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* It is well to dispense with this, if possible, from the possibility of leakage taking place during the subsequent vomiting. As an injection of cocaine will give almost as much pain as the fine trocar, the part may be frozen with the chloride of ethyl spray if needful.

† If this is presenting against the right ribs, another spot should, if possible, be chosen (foot-note, p. 349). Hydatids of the liver should never be explored or attacked through the ribs, if another site is obtainable.

Dr. Fagge (*Medicine*, vol. ii. p. 321) thought that the value of the aspirator must depend entirely on the position of the hydatid. If a large part of the cyst is outside the liver substance, the aspirator may be used with advantage; but if the cyst be almost entirely buried in the liver, Dr. Fagge thought the possible suction on a cyst surrounded by resistent tissue must involve some risk of setting up inflammation. Escape of bile, blood, or the setting up of a cough are indications for stopping. While the cannula is withdrawn the surrounding parts should be pressed around it, and rather depressed, so as to diminish the risk of leakage as the cannula leaves the cyst. The puncture is then closed with iodoform and collodion, and a small pad of dry gauze and salicylic wool comfortably secured by a many-tailed bandage. A little morphia may be given for the first twenty-four hours.

Practical Points.

1. Puncture alone is more likely to be radically curative in the following cases:—A small cyst, seen early. An acephalocyst. The more daughter-cysts, brood-capsules, and scolices present, the less likely it is that puncture will suffice. 2. Puncture is often very useful as a means of diagnosis in those obscure cases in which hydatids of the liver simulate disease of the pleura or lung. 3. Incision should be made use of where tapping fails, where scolices instead of fluid form the greater part of the contents of the cyst, where suppuration is present or imminent, and where chest complications are set up by the hydatid, showing perhaps a risk of perforation. 4. A few weeks after puncture secondary enlargement is often noticed. This is not undesirable as long as it subsides, which it usually will do gradually, being due to inflammation. On this account Dr. Fagge advised that no second operation on a hydatid should be performed within twelve months, unless suppuration is present. 5. Leakage after puncture may be shown by fluctuation, more or less distinct, in the flanks. The result of this seems to have been variable. In some cases it has been absolutely harmless, as in a case of electrolysis of mine mentioned below. In others it has been as certainly followed by fatal peritonitis. 6. Cases of hydatids treated by puncture should be watched for some time to make certain that the cure is a sound one. 7. The surroundings of hydatids of the liver are of truly vital importance, and sudden death has followed an operation more than once. Thus, in Mr. Bryant's case (*Clin. Soc. Trans.*, vol. xi. p. 230), while a hydatid cyst was being tapped, the portal vein, which had been pushed upwards and forwards by the projection of the cyst on the under-surface of the liver, was transfixed. Death followed in five minutes, and was thought by Dr. Fagge to be due to hydatid fluid being sucked into the vein as the trocar was withdrawn.

In a Russian case (*Lond. Med. Record*, 1885, p. 414) the pulse suddenly stopped while the cyst, which had been exposed by abdominal section, was being stitched to the incision. At the necropsy, a crumpled echinococcus had made its way into the right auricle, and a fragment of one into the right division of the pulmonary artery, by an opening between the thinned cyst and the inferior vena cava. Mr. Willett (*Brit. Med. Journ.*, Nov. 13, 1886) mentioned a case in which he had to aspirate a doubtful swelling of the liver. He used an ordinary-sized needle, and within two minutes the patient was dead. It turned out to be a case of malignant disease. No large vein had been pricked, and there was no hæmorrhage. The sudden, fatal syncope seemed due to the impression made on the nervous system through the solar plexus.

B. **Incision.**—The indications for this in preference to tapping have been given above. It may be carried out in one or two stages. The operation is thus performed: The parts being cleansed and the other preliminary steps taken, the surgeon makes an incision about four inches long over the most prominent part of the swelling (previously carefully percussed) down to the peritonæum. This incision should, if possible, be made in front. Even if a cyst or abscess shows its greatest point of prominence through the ribs, it should not be opened here unless it is quite certain that the pleural space is obliterated; moreover, the large drainage-tube needful necessitates resection of a portion of a rib. All hæmorrhage is next arrested, and the above layer carefully divided and sutured to the subcutaneous tissue in the edges of the wound with a few points of chromic gut. The liver is now recognised, and iodoform or sterile gauze tampons are carefully packed in on either side so as to prevent any escape of fluid into the peritonæal sac.

The needle of an aspirator or a fine trocar is then thrust in, and the existence of fluid beneath thus verified. As the needle is withdrawn the liver is incised, and a finger quickly plugs, and then enlarges to an inch and a half, the opening made by the knife. Hæmorrhage, if free, is easily arrested thus, or by sponge-pressure. Escape of fluids into the peritonæal sac is prevented by the use of the tampons already mentioned, by an assistant keeping the edges of the wound carefully adjusted to the liver, and, lastly, by the next step, which consists in hooking up the opening in the liver with the finger, and in stitching the edges of the wound in the liver to that in the abdomen with a continuous suture of chromic gut. While inserting this, care must be taken to unite peritonæum to peritonæum, and to take up a sufficiency of liver-tissue by inserting the needle well away from the edges of the wound. As the sutures are inserted the tampons, &c., must be gradually withdrawn, and, if the fluid escapes very freely, it may be well to turn the patient over on one side. Any scolices which are within reach are next removed, and, if the cyst is firmly stitched and the patient's condition good, the contents and wall of the hydatid may be cleared out with sponges on holders, aided by scoops. All handling must be of the gentlest. A large drainage-tube is then inserted, and the usual gauze dressings applied.

Operation by Two Stages.—An incision, four inches long, is made through the abdominal wall over the most prominent part of the swelling. All bleeding having been carefully stopped, the peritonæum is picked up and slit open. The liver, recognisable by its characteristic colour, is at once seen moving with respiration. To make certain of the position of the fluid, a fine trocar may be now thrust in. If the cyst be crammed with scolices, very little fluid escapes; if it be an acephalocyst, the fluid may spirt out under the high pressure not infrequently met with. After a few ounces have been withdrawn, any leaking is stopped by sponge pressure, the parietal peritonæum is stitched to the edges of the wound by a few points of chromic gut suture, the wound plugged with strips of iodoform gauze wrung out of carbolic acid (1 in 20), and the dressings firmly bandaged on with a good deal of pressure so as to keep the abdominal wall as far as possible in contact with the liver.* On the third day the operation is completed by incising the liver, now well adherent, and inserting a large draining-tube. I have operated by both methods on patients of my colleagues Dr. Pye-Smith, Dr. F. Taylor, and Dr. Newton Pitt. All the cases did well, though in two the complete filling up of the cavity was very tedious. One, a woman, three months pregnant at the time of the operation, went her full time subsequently.

C. **Electrolysis.**—This mode of treatment was used by Dr. Fagge and Mr. Durham in eight cases, and the results brought before the Medico-Chirurgical Society (*Trans.*, vol. liv. p. 1). The *modus operandi* here is uncertain, as in puncture, but it seems probable that neither the electrolytic action nor the leakage of fluid into the peritonæal sac, but the puncture alone of the needle, is the essential element. Thus, in a case of Dr. Playfair's, related in the appendix to Dr. Fagge's paper, progressive diminution, almost identical to that noticed after electrolysis, followed acupuncture only. This being so, and the method requiring special instruments, it has, I believe, fallen into abeyance. In one case, a patient of Dr. Moxon's, I made use of this method after previous tapping had failed. The steps taken by Dr. Fagge and Mr. Durham were carefully followed. Two electrolytic needles were passed into the most prominent part of the swelling, about two inches apart, and were then attached to wires both connected with the negative pole of a galvanic battery of ten cells. A moistened sponge connected with the positive pole was placed on the skin at a little distance. The current was passed for half an hour. The punctures were then closed with a pad of gauze. Indistinct fluctuation could be made out in the flanks during the next forty-eight hours. There was no constitutional disturbance, the tumour steadily diminished in size, and a good recovery took place. But I lost sight of the patient afterwards.

D. **Enucleation.**—A number of cases in which the cyst has been enucleated from the liver have now been reported, and the success met with has been considerable. Thus Posadas (*Revue de Chirurgie*, March, 1899, p. 374) reports twenty-three cases, of which nineteen recovered, and four died.

The tumour is exposed by a free incision, and isolated from the rest of the peritonæal cavity by means of tampons of iodoform gauze. After being emptied the whole cyst is enucleated from the liver, the incision in the latter then closed by means of sutures, and the abdominal incision sutured without drainage. This operation is clearly much more severe than incision and drainage, and moreover the mortality (over 17 per cent.) is very much too high. It should, therefore, not be performed except under very special circumstances, *e.g.*, when the cyst is small and partially pedunculated.

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* One case bulged out the right lower ribs most markedly. For reasons already given, I preferred to attack it in the front of the right hypochondrium. On exposing the liver, a hydrocele trocar passed through an inch and a half of hepatic tissue before fluid was reached. Very little hæmorrhage followed the completion of the second stage of the operation.

HEPATIC ABSCESS.—HEPATOTOMY.[*]

Tapping by a trocar, and draining the abscess by the cannula left in, or a drainage-tube passed through the cannula, the latter being then withdrawn, is unsatisfactory, for the following reasons:—(1) The cannula and tube may slip out. (2) The drainage is inefficient. (3) If the pus leaks into the peritonæal sac, it does so unseen. (4) The trocar may puncture important parts. Thus, in one case of Mr. K. Thornton's (*Med. Times and Gaz.*, 1883, vol. i. p. 89), the omentum, containing large veins, lay over the liver. (5) Puncture and drainage would be quite insufficient in cases where more than one abscess existed. It is to a free incision, therefore, that we must look for a permanent cure. This may be employed in three ways:

1. Direct incision and drainage, when tenderness, œdema, and redness make it probable that adhesions exist. This needs no further comment. 2. Incision and drainage by abdominal section in two stages. 3. Incision and drainage by abdominal section at one sitting.

The methods of treating an hepatic abscess by abdominal section, whether in one or two stages, have already been spoken of at p. 348, under the heading of Hydatids. They have the following advantages over other modes of treatment:—(*a*) The benefit of a free incision and thorough drainage; (*b*) the surgeon can see what structures he is dealing with; (*c*) bleeding from the liver can be seen and arrested; (*d*) if pus escapes into the peritonæal sac, this can be cleansed.

Very little need be said here of the treatment by abdominal section in addition to that already written at p. 348. In the two-stage method the surgeon will open the peritonæal sac, suture the parietal peritonæum to the edges of the wound, insert some gauze, and endeavour, by well-adjusted bandaging, to keep the abdominal parietes in contact with the liver, opening the abscess on or after the third day.

In the method by direct incision, a free incision of four or five inches is made and the parietal peritonæum united to the subcutaneous tissues of the wound. The position of the pus having been verified by a fine trocar or aspirator needle, tampons of iodoform gauze are carefully packed around. The abscess is then incised, and the opening at once plugged, and freely dilated with the finger. Any escape of pus into the peritonæal sac is prevented (1) by the careful packing; (2) by the finger hooking up the liver against the wound; (3) by an assistant keeping the parietes steadily against the liver. Hæmorrhage is controlled by forceps or sponge-pressure. When the abscess is empty[†] its opening is plugged with a sponge, and the liver and the parietes being still kept accurately together, the tampons first inserted are removed, and the edges of the liver wound stitched, with carbolised silk passed with curved needles on a holder, to the edges of the abdominal incision, care being taken to keep peritonæal surfaces well in contact. If the pus is fœtid the abscess cavity should be well irrigated with a dilute antiseptic lotion. A considerable thickness of dry gauze dressings will be needed at first, and will require frequent renewal. This will be facilitated by the use of a many-tailed bandage.

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[*] This term is also applicable to incision of the liver for hydatids.

[†] The late Mr. Greig Smith (*Abdom. Surg.*, p. 527) advised that, if the abscess does not empty itself readily, a large tube lying in carbolic lotion may be pinched at the end, and when placed at the bottom of the abscess will act as a syphon. He also draws attention to the need of exploring the abscess cavity for signs of a second abscess, and, if this be found, opening it with the finger or dressing-forceps. All manipulations now must be of the gentlest for fear of hæmorrhage.

Treatment of Cases of Hydatid or Abscess of the Liver which have opened, or which threaten to open, into the Chest.—I refer here to those grave and difficult cases where a hydatid cyst or hepatic abscess, instead of making its way towards the abdominal wall, works upwards, thrusting up the base of the lung. Perhaps the first few tappings have drawn off fluid from the front, but after this the cyst recedes from the epigastric region as in Mr. Owen's case (*loc. infra cit.*). In other and rare cases the cyst or abscess has been opened from the front or the side through the abdomen, but insufficient drainage is thus given. In such cases the advice given on p. 348 must be set aside, and the fluid must be drained through the pleura.*

Mr. Godlee sutured the diaphragmatic and costal layers of pleura round the edge of an aperture, made by removing a portion of rib, and then opened an hepatic abscess. Mr. Thornton, treating a similar affection with a view of obtaining a funnel through the pleura, along which the pus could escape safely, first raised the parietal pleura all round, so as to get a little free edge, then made a very careful longitudinal incision through the visceral pleura, raised it all round, and then with a fine curved needle united the two layers with a continuous fine silk suture. A channel being thus made, the liver-abscess was opened by a curved trocar, the puncture converted into an incision, and a large drainage-tube inserted. Mr. Owen, in the case of a hydatid cyst which encroached upon the thorax, incised the eighth intercostal space, first behind the anterior axillary line. As soon as the costal pleura was divided, air rushed freely in with a very audible sound, and, the finger being introduced, the diaphragm was at once felt bulging up along the inner surface of the ribs, while the lung had retired beyond reach. The intercostal space, which was fairly roomy, was forcibly widened, but it was not thought necessary to excise a piece of rib. The phrenic pleura and the diaphragm were then carefully incised, and the abdominal cyst was discovered. A certain amount of its contents were withdrawn by aspiration, so as to relieve its tension, and to permit of some of the face of the sac being drawn through the diaphragm, and across the shallow pleural cavity to the skin wound, to which it was secured by four hare-lip pins. The serous surfaces thus placed in contact were found firmly adherent on the fourth day. An incision was then made into the cyst, and a drainage-tube inserted. All three patients recovered.

REMOVAL OF PORTIONS OF THE LIVER FOR NEW GROWTHS.

This operation will always remain a rare one from the infrequency of growths which admit of removal. Keen (*Ann. of Surg.*, Sept. 1899, p. 267) has, however, collected no less than seventy-four cases, in an important paper from which most of what follows has been gathered. The mortality has so far been only 14·9 per cent., so that the risk of the operation is certainly not a very serious one. Some idea of the variety of tumours that have been removed from the liver may be obtained from the following list which Keen gives:—Constricted, accessory, or herniated left lobe, five cases; syphiloma, twelve cases; carcinoma, seventeen cases; adenoma, seven cases; sarcoma, five cases; angioma, four cases; cavernoma, one case; cystoma, one case; angio-fibroma, one case; small calculi, one case; endothelioma, one case; hydatid cysts, twenty cases.

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* Mr. Godlee (*Brit. Med. Journ.*, 1887, vol. ii. p. 872), Mr. K. Thornton (*ibid.* 1886, vol. ii.), Mr. Owen (*Clin. Soc. Trans.*, vol. xxi. p. 78), and others have successfully adopted this course.

The chief difficulty met with is hæmorrhage; this has, however, been satisfactorily controlled, either by isolating the tumour by means of an elastic ligature before removal, or by dividing the liver-substance with the cautery, and ligating any large vessels met with while this is being done. Keen removed a carcinomatous left lobe weighing one pound and five ounces in a man aged 50, by the latter method, which he describes as follows:—

"The operation was done entirely with the Paquelin cautery. It took from twenty to thirty minutes to sever the left lobe from the remainder of the liver. The hæmorrhage was not very severe, excepting when I burned into some of the larger veins. Each of these, when opened, I was able instantly to close by my left forefinger. Then, temporarily laying aside the cautery, I passed a catgut ligature under each by means of a Hagedorn needle, and one of my assistants tied it slowly but firmly. Five ligatures were thus applied. Three of the veins required ligatures of both of the divided ends. The hæmorrhage, except from these large veins, was arrested by the Paquelin cautery, except that occasionally, when I laid aside the cautery to apply a ligature, temporary packing with iodoform gauze was of great service in arresting the parenchymatous hæmorrhage." The cavity left was partially occluded by means of sutures, the remainder being loosely packed with gauze. Complete recovery took place.

In other cases the charred surfaces after suturing have been treated without drainage without any untoward result.

When the elastic ligature is employed, long steel pins are so placed as to prevent the ligature from slipping, and the tumour then removed half an inch beyond the ligature. The wound is then closed round the stump, which must be carefully kept aseptic. In a case treated successfully in this way by Mayo Robson, the pedicle left was as thick as the wrist, and after the separation of the slough a granulating surface was left. This gradually contracted, and the patient made a good recovery.

OPERATIONS ON THE BILIARY TRACTS: CHOLECYSTOSTOMY — CHOLECYSTOTOMY — CHOLELITHOTRITY — CHOLEDOCHOTOMY — CHOLECYSTENTEROSTOMY — CHOLECYSTECTOMY — TREATMENT OF BILIARY FISTULA.

As the indications for these operations are nearly always gall-stones or their complications, it will be well first to briefly consider the different sites in which biliary calculi are met with and the chief evidence by which they may be differentiated, it being always understood that, as several of the following conditions may coexist, the symptoms to which a group of gall-stones in one position gives rise often runs into those of another. (i) *The calculus or calculi are in the gall-bladder.* The symptoms here will be chiefly recurrent attacks of colic, associated with local tenderness and often with pyrexia. No swelling may be present unless a calculus exists lower down, and for the same reasons there will be no jaundice. (ii) *The stone or stones are in the cystic duct.* Here there will be colic, and presence of a swelling having the characters of a distended gall-bladder. Jaundice is as a rule absent, but if a calculus in the cystic duct makes pressure on the common hepatic duct this point of guidance will be lost. (iii) *The calculus, one or more, occupies the common duct.* This, according to the duration of the mischief, will be more or less dilated, and the same applies to the tracts behind, unless other calculi are present here. In addition to colic, jaundice will be present, and if adhesions are forming, if any ulceration and septic process is going on, pyrexia may be present also. The gall-bladder, as pointed out by Mr. Terrier, Mr. Mayo Robson, and others, is usually contracted, shrunken, and matted down by adhesions in these cases, so that no tumour will be present. Should distension of the gall-bladder be present in association with the symptoms mentioned above, it is to be looked upon as pointing rather to malignant disease than to the presence of gall-stones. Other points which may help in deciding between these two conditions are the time the trouble has lasted, the persistency of jaundice, and the age and general condition of the patient.

Mr. Mayo Robson (*Med. Ann.* 1898) points out that calculi are more often situated in the common bile-duct than has been hitherto supposed, having found this condition in 20 per cent. of two hundred operations performed for gall-stones. The same author also draws attention to the very important fact that multiple calculi in the common duct are more frequent than solitary ones.

In addition to the above it must be remembered that gall-stones are generally associated with inflammatory complications, which vary greatly, both as regards the parts involved and the intensity of the process. Even in the most simple cases some degree of adhesion from local peritonitis will be present, and in the more complicated cases the difficulties that the operator may have to face may be extreme. Some of these will be referred to later in the accounts of the various operations. The following may be mentioned as some of the special complications of gall-stones that may call for surgical intervention :—Empyema of the gall-bladder, abscess around the gall-bladder or bile-ducts, suppurative cholangitis, chronic catarrhal inflammation of the gall-bladder and bile-ducts, and phlegmonous cholecystitis.

An operation for gall-stones is usually, in the first instance, undertaken for exploratory purposes, the special operation which is called for being then undertaken, according to the conditions found to be present. The steps of the exploration will therefore be first described, and the details of the separate operations given subsequently.

As a prophylactic against the troublesome hæmorrhage which is liable to attend operations upon patients suffering from jaundice, Mayo Robson (*Diseases of the Gall-bladder and Bile-ducts*) recommends the administration of chloride of calcium. He prescribes thirty-grain doses every four hours for a few days before operation, and continues the administration for some time after the operation, giving it either by the mouth or per rectum.

Operation.—In order to render the parts more accessible, Mayo Robson (*loc. supra cit.*) places a firm, narrow sand-bag under the patient's back at the level of the liver. This brings the common duct two to three inches nearer to the surface, and also tends to open out the costal angle, and displace the intestines downwards away from the liver.

The anæsthetic will usually be the A.C.E. mixture or chloroform, ether being unsuited to many of these patients, often middle-aged and stout and flabby, and the subjects of chronic bronchitis. The abdomen having been cleansed, one of the following incisions is made use of:—(1) A vertical one, over the prominence of any swelling present, or straight down from the tip of the cartilage of the tenth rib. It should be four inches long to begin with, and should be prolonged down to the level of the umbilicus if more room is wanted for the exploration of the common duct. This incision, if the wound be widely retracted, will answer in nearly all cases. Where the adhesions are very difficult to deal with, more room may be got by adding to it a transverse incision carried inwards along the margin of the ribs at its upper extremity. Another very useful incision which is always employed by some operators, and which is excellently suited for those cases where much difficulty is expected, is a transverse or curvilinear one, starting a little below the tip of the ninth rib, at the outer edge of the rectus, and passing in a transverse or curvilinear direction into the loin; if extra room is needed it may be carried as far as the outer edge of the quadratus lumborum.* Either of the above incisions will give better access than one in the linea semilunaris or linea alba. The second one gives the best access of all, but we must wait for the results of cases which have been adequately watched before we can accept as certain the statement that the transverse incision is no more likely to be followed by a ventral hernia than is the vertical one, because it is in the upper and firmer part of the abdominal wall. The peritonæum having been reached, any vessels which need it are secured with chromic gut. The peritonæum is next picked up and opened. The gall-bladder and bile-ducts are then carefully explored, and a decision come to as to the further measures that will be necessary.

CHOLECYSTOSTOMY.

If the gall-bladder is distended and free from adhesions, it is isolated by means of iodoform or sterile gauze, then aspirated and opened.

If, on the other hand, the gall-bladder is small and shrunken and imbedded in adhesions, these must now be dealt with. The difficulties met with here may be due merely to omentum or distended intestines cealing the gall-bladder, or adhesions may have taken place about s structure to a varying degree. The following case of Mr. Robson's good instance of the difficulties which may be met with :

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* This incision is recommended by Mr. R. Morison, of Newcastle-on-Tyne (*Ann. of Surg.*, August, 1895, p. 181). He gives the credit of it to Dr. John Duncan, of Edinburgh. Besides the excellent access which the incision gives, there is another advantage which will be given when the subject of drainage is considered. This incision is practically the same as Courvoisier's, much used on the Continent and in America—viz., an incision about ten inches long, running obliquely parallel to the lower border of the right ribs, and about half an inch below them, with its centre lying over any swelling that is present.

he tumour on being exposed "seemed to be composed of liver, gall-bladder, uach, and omentum matted together. No fluctuation could be made out, and the our seemed so firm, hard, and nodulated as to give the impression of being malig- t. An exploring syringe pushed deeply into the swelling simply withdrew a little d! but on pushing the needle through the overlapping edge of the liver, in the ction of the cystic duct, pus was withdrawn. On attempting to separate the liver n what was supposed to be the gall-bladder, pus began to well up, but fortunately e of it escaped into the peritonæal cavity, as sponges had been packed round the ning. On dilating the opening sufficiently to admit the finger, gall-stones were at felt, one of which, about the size of a small walnut, was easily removed; the nd, impacted in the cystic duct, broke in removal, leaving the distal portion still hin the duct; this was removed with considerable difficulty, as, on account of the ting of the parts, the finger could not be passed beyond the cystic duct to aid in xpulsion; after its removal the index finger, on being pushed into the duct as far possible, discovered another impacted stone, which it was found impossible to ove. As the sequel showed, this was perhaps rather a happy circumstance, for, on unt of the depth, the friability, and the adhesions of the gall-bladder, it was d impossible to suture it to the surface, as the stitches would not hold; hence, r the suppurating cavity had been washed out with a solution of fluosilicate of (gr. x.—Oj) and a drainage-tube inserted, the upper and lower ends of the sion were drawn together by silk sutures so as to somewhat limit the opening. peritonæal cavity was left freely open, two sponges being placed on each side the ning into the gall-bladder so as to absorb any discharge flowing out of it. They e at first changed every two hours, antiseptic precautions being adopted. At the l of two days they were removed, one being simply applied directly over the inage-tube, so as to press the parietal peritonæum into contact with the visceral."

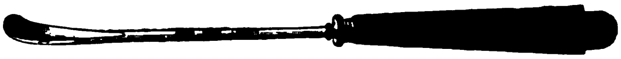
The patient made a complete recovery.

In some cases the gall-bladder may be actually buried in adhesions, volving such structures as the abdominal wall, omentum, duodenum, d pylorus. The liver must be pushed up and the intestines held aside th iodoform gauze tampons, so arranged as to shut off the general ritonæal sac. The adhesions are then most carefully separated with fine blunt dissector (Fig. 92), a steel director, or curved scissors, eeding, chiefly troublesome oozing from adhesions, being checked by gature or by firm pressure with gauze. While this is being effected e operator must be prepared in some cases for an escape of pus, which s been shut in by these adhesions, outside the gall-bladder or the cts lower down. In one case of Mr. Thornton's (*Brit. Med. Journ.*, 86, vol. ii. p. 902), the majority of the stones—412 were removed— y in a cavity in the liver substance. Through the liver-tissue hich presented in the incision stones could be felt moving on each her: the gall-bladder was small and atrophied; a large stone occupied e common duct. Here the large stone originally in the gall-bladder d become impacted in the common duct, the other stones being med in the hepatic duct and above it in the liver, where they dually hollowed out a cavity.

The gall-bladder having been found and freed from adhesions, is ught into the wound if possible, and having been isolated by means gauze tampons, it is first emptied by aspiration; the puncture is n enlarged, and a forefinger inserted to feel for calculi. If it is clear resent will be difficult of removal, the edges of the opened gall-bladder should be sutured to the margins of the wound by a continuous suture of sterilised silk, or by interrupted ones at short intervals. The parietal peritonæum must be carefully taken up, and the sutures passed at a sufficient distance from the edges of the gall-bladder and the incision in the abdominal wall to ensure a good hold. The sutures should pass through any bleeding points in the cut gall-bladder. and, as they are inserted, the sponges or tampons should be withdrawn. Mr. Mayo Robson (*loc. supra cit.*) strongly advises the following method of suturing the gall-bladder as likely to prevent a permanent fistula: The serous coat of the gall-bladder is sutured to the parietal peritonæum, and the mucous coat to the aponeurotic layer of the abdominal wall, thus leaving the skin and subcutaneous tissue free to granulate and close the opening.

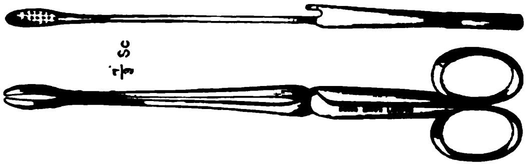
The gall-bladder having been thus safely steadied prior to any manipulations which may be needful—and the extraction of a stone fixed low down in the cystic duct is often a prolonged affair—any calculi which lie near the surface are removed with scoops (Fig. 149), dressing-forceps, or the forceps shown in Figs. 150 and 151. Of these I have found the one to the left of Fig. 151, though its blades appear somewhat clumsy, very efficient in extracting stones when the ducts are dilated. Where a stone impacted low down in the cystic duct resists all efforts at extraction from the gall-bladder by scoops or forceps, attempts must be made to push it up into the gall-bladder by a finger introduced into the abdomen through the lower part of the wound. This, after the gall-bladder has been secured by sutures, is left open—kept plugged with iodoform gauze or a carbolised sponge—so that a finger can be introduced from time to time to assist any instrument working from the gall-bladder, or to dislodge any calculus out of the cystic duct. If all attempts at removal or dislodgment fail, the calculus must be treated by cholelithotrity, choledochotomy, or cholecystenterostomy (*vide infra*).

FIG. 149.



Lawson's Tait's scoop for gallstones. (Down's Catalogue.)

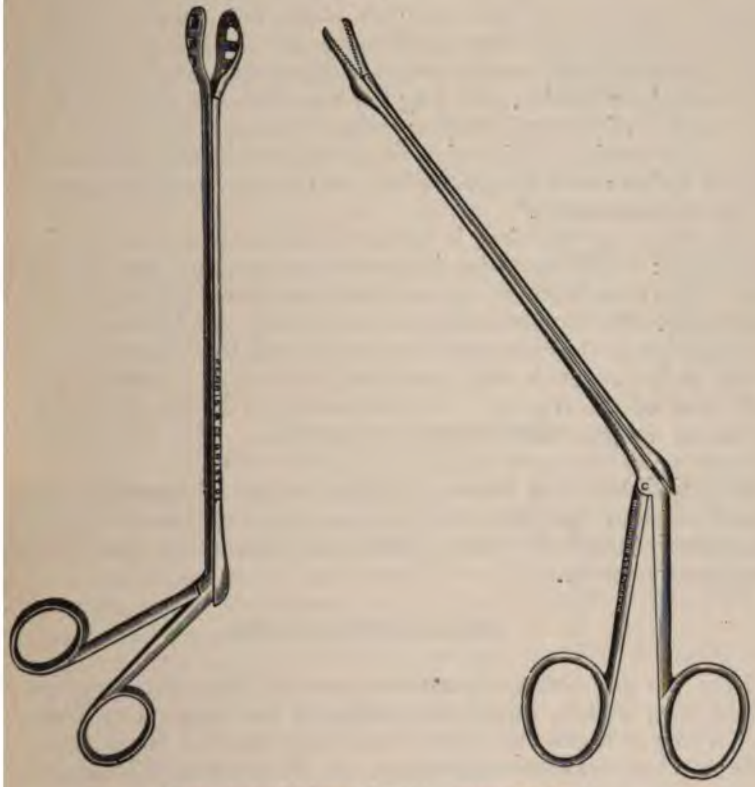
FIG. 150.



Anderson's forceps for the extraction of gallstones. As the blades unlock, either can be introduced separately, and then used as a probe or scoop. In a difficult case these forceps are very helpful. (Down's Catalogue.)

In some instances it will not be possible to bring the gall-bladder up to the abdominal incision and suture it there. Mayo Robson meets this difficulty as follows. He says, "It has at times been possible to tuck down the parietal peritonæum to the edges of the gall-bladder ning, and so to effect suture of the contiguous margins; but in eral cases where this could not be done the right border of the omen- has been sutured to the margin of the gall-bladder opening and to

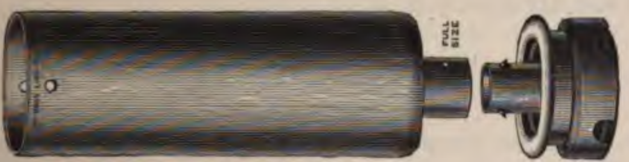
FIG. 151.



Tait's cholelithotomy forceps. (Greig Smith.)

parietal peritonæum, thus forming a tube of peritonæum around drainage-tube, and shutting out the general peritonæal cavity." either of these plans is available, a tube should be placed in the

FIG. 152.



(Down's Catalogue.)

-bladder and surrounded with gauze packing. This will be found te efficient in preventing leakage into the peritonæal cavity.

urphy's Drainage-tube Button (Fig. 152).—This is a modifi- on of the inventor's well-known anastomosis button, in which the female half is elongated to form a drainage-tube, so as to reach from the deep-seated gall-bladder to the surface. The following is the way in which it is used: "The gall-bladder is located, a sufficient surface of its wall exposed, the contents aspirated, the purse-string suture (Fig. 103, p. 269) inserted, the gall-bladder is incised, the small half of button inserted, purse-string tied and cut short, the tubular portion of the button is then pressed into position, the tube is then drawn out as far as the gall-bladder will permit, and held there with a pin passed through the opening in its side. During the time that the pressure atrophy in the portion of the gall-bladder clasped between the button is taking place, a cicatricial wall is being formed about the tube which acts as the wall of a sinus after its production, and insures continued protection of the peritonæal cavity."

The following criticism is by an American surgeon, Dr. Binnie (*loc. supra cit.*): "This operation is extremely ingenious, but in many cases, especially those in which its use would otherwise help us most, it is inapplicable. If the gall-bladder is deeply seated, and its walls friable, the introduction of the purse-string suture would be difficult or impossible. If the gall-bladder is very small and shrunken, it cannot contain the male half of the button. If the opening is in the duct, the button operation is generally out of the question. For these reasons the Murphy operation must be of very limited utility."

This *operation* has been performed *in two stages*, as in opening a hepatic abscess (p. 350), but this is quite needless here, unless the anæsthetic should be taken badly or some other quite unforeseen complication occur.

CHOLECYSTOTOMY.

Here the gall-bladder is sutured at once after the extraction of the stones, *e.g.*, with a continuous suture of the mucous membrane, and then a row of Lembert's sutures, and returned into the peritonæal sac. This step has two grave objections. (1) It is not so safe as cholecystostomy, owing to the risk of leakage if the walls of the gall-bladder are at all inflamed and softened. This is just an instance of an operation where we hear of the successful, but never of the unsuccessful cases. (2) It is very difficult to be certain that all the ducts are patent. If a stone be left behind, suturing and returning the gall-bladder will give rise, in the immediate future, to dangerous tension on the sutures by the back-flow of the bile, while it prevents, later on, any attempts being renewed through the open gall-bladder.

CHOLELITHOTRITY

The term has been applied to crushing a gall-stone inside one of the ducts. The method was first adopted by Lawson Tait, who made use of forceps in order to crush the stone. This plan, however, is not to be recommended, owing to the danger of injuring the wall of the duct. Mayo Robson (*loc. supra cit.*) crushes the stone by pressure between the thumb and finger, and reports thirty-one cases in which he has adopted this plan without any subsequent trouble from damage to the ducts.

In the case of the common duct, the left forefinger is passed through the foramen of Winslow behind the stone, and the thumb is placed in front of it. Pressure first produces flattening of the stone; but on changing the position of the fingers so that the edges of the flattened stone are pressed together, fracture into a number of small pieces usually takes place. These are then pressed on into the duodenum or washed through.

Stones which are too hard to be crushed in this way should be removed by choledochotomy, unless the condition of the patient forbids anything further being done. In this case the action of solvents applied through the cholecystostomy wound must be tried.

Impacted stones have also been broken up by means of a needle passed through the wall of the duct. Mayo Robson and others have come to the conclusion that this method is unadvisable on account of unavoidable damage to the ducts.

The chief objection to cholelithotrity is the difficulty of completely clearing the ducts of *dêbris*. On this account cholecystostomy should be performed at the same time, and the ducts thoroughly syringed through with warm sterile water.

CHOLEDOCHOTOMY.

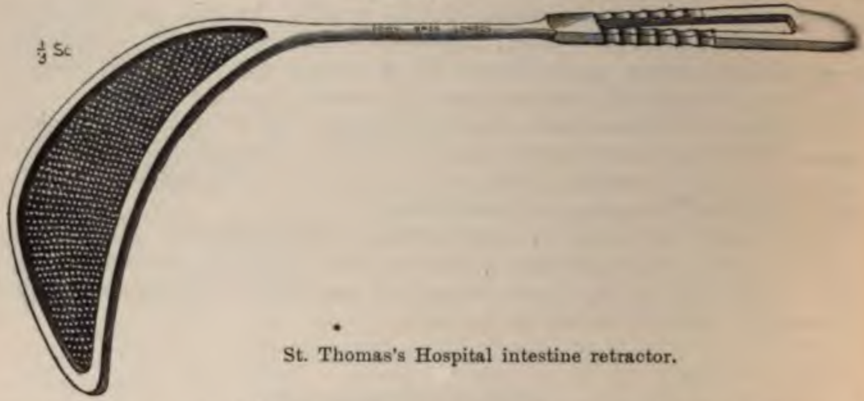
This term has been given to the operation of removing stones from the biliary ducts by direct incision. This method has gained ground very much of late years. Its safety in careful and competent hands has been established, and it has been proved that stones impacted deep in the cystic or in the common duct, which otherwise must have been left behind as persistent sources of misery or as causes of an open biliary fistula, extraction by opening the gall-bladder or cholelithotrity having proved impossible, can now be safely removed.

While the important relations of these ducts—especially the common—must always be remembered, the presence of the stone itself forms a reliable guide, as long as the incision is made directly over it.

We will take the operation for removal of a calculus from the common duct. The incision in the abdominal wall being lengthened if necessary so as to give satisfactory exposure of the parts concerned. the liver is held up, the edges of the wound are held widely open, and the position of the stone accurately defined. One of the retractors shown in Figs. 153 and 154 may here be found useful in keeping back the intestines. The area of operation is then carefully shut off by iodoform gauze packing and sponges secured to forceps, and any adhesions over the stone are very carefully separated while the duodenum is drawn down or turned aside. The stone, firmly held, is raised as high as possible. The incision is not to be made until the surgeon feels certain that he is directly over the stone. The escape of bile, which is very profuse if it has been long pent up or if the blocked duct is dilated, must be met by assiduous sponging or washing away with boiled water.

After removal of the main stone the ducts must be thoroughly and systematically explored; for as has already been pointed there are usually several stones present, and the failure to remove them all will render the operation useless. This exploration should be carried out with the finger if the ducts are sufficiently dilated, or failing this by a bent probe or small scoop. The finger, however, should be employed wherever possible, because it is the only really certain method. Mayo Robson strongly emphasises this point, and mentions a case in which a probe and scoop failed to discover a stone which was found afterwards on digital examination.

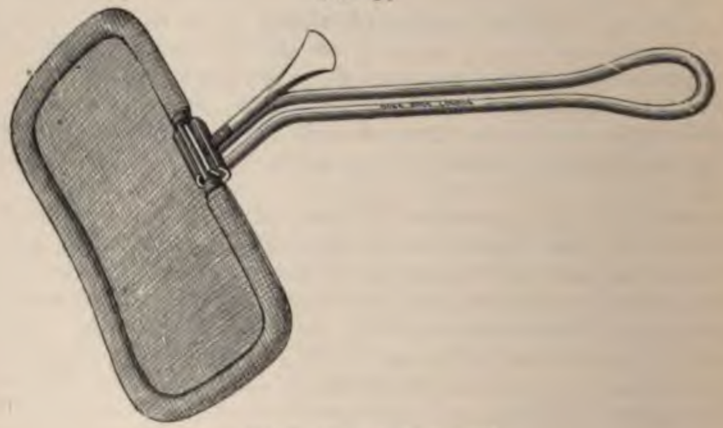
FIG. 153.



St. Thomas's Hospital intestine retractor.

The ducts having been cleared, it remains to consider the different means of treating the opening in the duct. If the passages above and below are patent, if the opening is accessible, and if the patient's condition admits of further prolonging of the operation, sutures should certainly be employed for the additional security which they give.*

FIG. 154



Maunsell's intestine guard.

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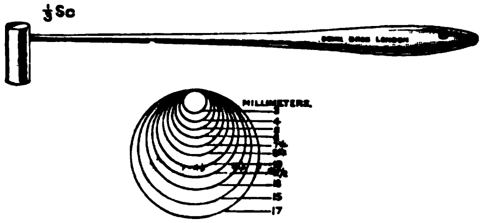
* Even if the sutures do not hold, they do good by preventing or lessening the escape of bile while adhesions are forming to shut off the peritonæal sac.

The escape of bile being prevented by the pressure of the fingers above the opening, the incision by which the stone has been extracted is closed by a continuous suture of chromic gut for the duct itself, while a second set of sutures of silk are used to draw together the cut edges of the overlying peritonæum. The sutures are best inserted by a small fully-curved needle held in pressure-forceps, by Mr. W. A. Lane's cleft palate needles held in his special needle-holder (*vide* Fig. 197, vol. i.), or, as recommended by Mr. M. Robson, by a rectangular cleft-palate needle. The value of a free incision, opening up the wound in every direction, pulling up the liver, drawing down the duodenum and colon, and, perhaps, the use of an electric lamp, will be very apparent now. The assistants must be assiduous with well-applied sponge-pressure. In the words of Dr. Binnie, of Kansas City (*Ann. of Surg.*, Nov. 1894, p. 563): "A difficulty which occasionally confronts the surgeon is to distinguish at the bottom of a deep and narrow pit the wounded duct from oozing adhesions recently divided."

FIG. 155.



Halsted's Hammer.

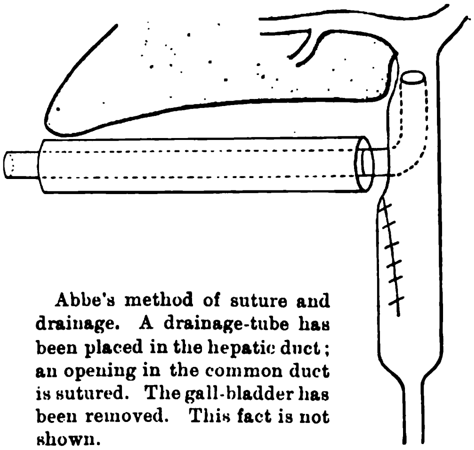
Mr. Halsted (*John Hopkins Hosp. Bull.* April 1898) recommends the use of a small metal hammer in order to facilitate the introduction of sutures. The head of the hammer is made in a variety of sizes and is fitted with a long slender handle (Fig. 155). The hammer chosen should be large enough to fully distend the duct. The head of the hammer is passed through the incision in the duct and serves to steady the latter and also to lift it up towards the surface while the sutures are passed. The hammer is then removed and the sutures tied.

Where the opening cannot be sutured, the surgeon will use either some of the adjacent soft parts to act as a dam between the duct and surface, and so prevent the bile from entering the peritonæal sac, or he will employ drainage and iodoform gauze. Amongst the soft parts that are handy, the omentum at once presents itself as the most available. Mr. Mitchell Banks (*Liverpool Med.-Chir. Journ.*, 1893, p. 307) in a case of cholecystostomy, in which the incision in the gall-bladder could not be united to that in the abdominal wall, made use of "the round ligament of the liver and some neighbouring omentum, which he fastened to the gall-bladder and succeeded in so banking it up as to prevent the bile from flowing into the peritonæal cavity." Binnie, of Kansas City (*loc. supra cit.*), made use of separated adhesions, after extracting a calculus through the opened cystic duct.

"Suture of the wounds in the bladder and the duct might have been possible, but as it would certainly have taken much time I decided to drain, but at the same time to build up, of omentum, mesentery and existing adhesions, a diaphragm between the track of the drain and the general peritonæal cavity. Thus the wounded biliary passages were left open, a few stitches of catgut, judiciously placed, bound together the various structures above mentioned in such a way that in a few hours they became an impervious rampart of adhesions. . . . A rubber drain was also passed to the bottom of the wound, and surrounded throughout its whole length with a liberal supply of iodoform gauze."

Drainage.—It will be safer to always use this in some form or other* whenever the ducts have been incised, but with more elaborate precautions, of course, when no sutures have been inserted. To take the latter case first. A curved glass tube,† with the end turned upwards, should always be inserted if possible into the opening in the duct—an easy matter when these are much dilated. It should then be carefully packed around in its whole length with iodoform gauze. The readiness with which this forms adhesions, leading to bleeding and difficulty in detaching it, is well known to those who have used it in abdominal surgery.

FIG. 156.



Abbe's method of suture and drainage. A drainage-tube has been placed in the hepatic duct; an opening in the common duct is sutured. The gall-bladder has been removed. This fact is not shown.

Dr. R. Abbe, of New York, recommends the method of drainage shown in Fig. 156, which he has used successfully (*loc. supra cit.*). A stone having been removed from the common duct, a large drainage-tube was passed into the hepatic duct through the opening in the common duct, this opening being then sewn up with fine silk. Around the tube which emptied the hepatic duct a larger one‡ was placed, reaching to the common junction, and a light iodoform tampon was finally pushed in. All the bile came through the tube for five days; the inner one was removed on the second day, and the sinus closed in three weeks, the patient making an excellent recovery.

Where the opening has been closed with sutures it will still be wise to use a drainage-tube for a day or two, the indication for this being clearer in cases where the suturing has been attended with difficulty, where the edges of the duct are much bruised, and where any contraction may exist in the biliary passage below.

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* It has been stated that drainage is not needed as pure bile does not excite peritonitis. I am of opinion that the surgeon can rarely tell for certain whether the bile is pure or not. Certainly in cases where there have been repeated attacks of cholelithiasis with pyrexia it is extremely probable that the bile is infected from the intestines—*e.g.*, with the *bacillus coli communis*. And this is the more likely when any part of the ducts has been long dilated into a large sac.

† If the flow of bile is profuse, syphonage (p. 383) may be adopted, rubber tubing being attached to the glass tube.

‡ If glass tubes are used care must be taken that the end is not jammed against the structures with which it is in contact, otherwise ulceration may readily follow.

If any bile has escaped into the peritonæal sac—a rare contingency if the gauze packing has been careful—there are two places where it may be well to insert a drainage-tube. One, if the flow has been very free, is in Douglas's pouch by an incision above the pubes; this will be seldom required. The second and more suitable spot is one to which Mr. Morison, of Newcastle, has drawn attention (*Brit. Med. Journ.*, vol. ii. 1894, p. 968). He there shows that in the right hypochondrium, between the liver and the colon, is a natural space with barriers which separate it, more or less completely, from the general sac. Bile may be allowed to escape into this space, as long as it is efficiently drained by an incision made through the posterior parietes immediately below the lower end of the right kidney. If the curved incision which Mr. Morison and others recommend (p. 354) be made use of, the drainage-tube will be in the lower and outer angle of the wound.

Before leaving the subject of extraction of stone from the biliary passage it remains to refer to one lodged so far down in the common duct as to be practically immediately outside the duodenum. As might be expected, such stones are very difficult to identify. The peritonæal sac having been opened, any omentum adherent to the abdominal wall or the neighbourhood of the liver must be separated, other adhesions carefully divided, and the gall-bladder identified, if possible, as a guide. The pylorus, duodenum, and transverse colon must also be identified and drawn to the left downwards. The liver must be kept well up out of the way with retractors or the fingers of an assistant. The identification of the common duct will now vary in difficulty according as its relations are natural or matted by adhesions. If the former is the case, the stone being exactly taken as a guide, a vertical incision is made through any fold of peritonæum passing down to or in front of the mesocolon, including the mesocolon. The vertical incision is deepened with a blunt dissector or the finger until the head of the pancreas is exposed and the deeper surface of the duodenum, including the whole length of the common duct. This will be facilitated by pulling the duodenum well over to the middle line. The importance of working most carefully just over the stone is shown by the relations of the common duct: "This receiving the cystic and hepatic ducts about two inches below the liver in the beginning of its course lies directly in front of the portal vein. Below, before it enters the duodenum, it crosses the inferior vena cava. Its orifice admits the passage of a probe or director pretty easily." (Richardson.)

Another proof of the importance of the relations of the common duct, is shown by the fact that even in Mr. Mayo Robson's experienced hands, fæcal extravasation took place from a small perforation in the colon, caused by the separating adhesions during the removal of a stone from the common duct, the injury being unrecognised at the time. Another instructive case is that of Ross (*Canadian Practitioner*, April, 1894). Here several stones were lodged in the common duct, the duodenum was accidentally torn, and this opening was enlarged in the hope of reaching the stones through the opening in the duct, but this point could not be found. The common duct was accordingly opened and the stones removed. The duct was sutured, but owing to the friability of the tissues at the site of the roughened stone, it was impossible to prevent the leakage of bile. Drainage was employed with iodoform gauze. The bile continued to flow, but increased suddenly after vomiting, and the case ended fatally fifty-six hours after the operation.

The site of the stone having been reached with certainty,[*] the following methods are open to the surgeon: (1) Pushing it into the intestine, or upwards into a more accessible position. If this fail, a trial may be made of breaking up the stone with the finger and thumb. (2) The duct may be incised either directly, if it can be detached from the pancreas, or through the tissue of this viscus. Dr. T. A. McGraw, of Detroit, adopted this latter plan successfully, having first made certain of the stone by a puncture with an exploring needle. This most capable operator is inclined to think that an incision into the duct through the pancreas is preferable to one through the duct wall only, as the surgeon is thereby enabled to apply two or three tiers of sutures.[†] (3) The stone may be removed through an incision in the duodenum, adopted by Dr. McBurney, of New York, Mayo Robson, and others, or a finger introduced through the incision in the bowel may dislodge the stone and enable it to be pushed upwards into a more accessible point in the common duct where choledochotomy may be performed. The opening in the intestine is subsequently sutured. This plan is spoken highly of by Mayo Robson, who has adopted it seven times, five of the patients recovering. He says "for calculi situated in the lower third of the common duct, especially if impacted in the diverticulum of Vater, the operation is decidedly preferable to the ordinary choledochotomy, as not only is it easier, but an incision of the narrow orifice of the bile-duct in the duodenum leaves a patent opening, which will allow any other concretions that may have escaped observation to pass without difficulty."

CHOLECYSTENTEROSTOMY.

In this operation a communication is made between the gall-bladder and the small or large intestine. Whenever feasible the duodenum or upper jejunum should be preferred. When the small intestine is too matted by adhesions to come up sufficiently, the hepatic flexure of the colon should be chosen. It has received great impetus lately owing to the recommendations which it has received from Dr. Murphy, of Chicago, the facility with which it can be performed with his most ingenious and expeditious button, and the good results which the published cases show. The chief **indications** for the operation are: (1) Irremediable obstruction of the common duct, due to calculus or cicatricial contraction. The second cause is very rare, and it is probable that as time goes on and surgery proves what can be done for calculi impacted here, this indication will very rarely arise. (2) In obstruction of the cystic duct, where cholecystectomy is impracticable. (3) A persistent fistulous opening after operations on the gall-bladder, or due to stricture, or occlusion of the common duct, giving rise to a constant escape of bile, causing persistent excoriation and annoyance, owing to the eczematous rawness. In such cases the operation of cholecystenterostomy was recommended ten years ago in this country by Mr. Willett (*Brit. Med. Journ.*, vol. ii. 1886, p. 903). (4) Mayo Robson also gives chronic pancreatitis.

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[*] A stone, impacted in the duct, low down, may give a hard or nodular feel which may suggest malignant disease of the head of the pancreas: an exploring needle will clear up the case.

[†] It is noteworthy that in Dr. McGraw's case, the jaundice and the itching were both intensified for the two days which followed the operation. This was attributed to obstruction from a blood clot or due to swelling of the incised tissues. It is just possible that it may have been due to over-complete suturing. If the duct is not dilated there must always be a risk of closing its lumen for a time.

(5) Another indication which has been sometimes given is malignant disease about the head of the pancreas occluding the common duct and giving rise to jaundice, itching, &c. In such cases cholecystenterostomy must involve greatly increased risk. Hæmorrhage and imperfect repair are the chief dangers, the first especially so, as will be seen from the case given below of Dr. F. J. Shepherd of Montreal (p. 367). Dr. Murphy himself (*Chicago Clin. Rev.*, Feb. 1895) considers the operation here very unsatisfactory, there having been seven deaths out of the eight cases. Two died from shock, one from a twisting of the small intestine, before the approximation was made, a volvulus being thus produced. In another case the gall-bladder was so friable that it tore like wet paper when the sutures were inserted, and after the button was in position and the abdomen closed, the friable wall gave way and peritonitis followed. Dr. Murphy accordingly advised that if the operation be made use of in case of obstruction due to malignant disease, it should only be in the early stage.

The indications for cholecystenterostomy having been given, the means of performing the operation will next be considered. These are: (1) Suture alone; (2) Suture, aided by one of the bobbins now coming into use, so as to give support to the sutures and facilitate their insertion. Of these, Mr. Robson's is, I believe, the only one which has been used as yet. Two cases are very briefly given (*Brit. Med. Journ.*, vol. i. 1894, p. 902). In one of them, when the dilated cystic duct had been united to the colon, the jaundice recurred a few months later. (3) Murphy's button. Cholecystenterostomy by this method requires careful attention. The attractiveness which the simplicity of this most ingenious device must always carry with it, the success * which it has met with in skilful hands, make it very probable that, in the zeal of securing an immediate success, this operation may be performed, if it had not already been so, much too often. Thus, to take both sides of the question, on the one hand we have these *advantages*: the two viscera which are to be united are often readily reached by a comparatively small incision. The button is very quickly adjusted, the bile soon passes by the new channel, the jaundice and itching are lost and the fæces again become natural. On the other hand the following *objections* present themselves to every candid and well-informed thinker. (1) It is clear from the account of several of the cases that the cause of all the trouble might have been removed, and not only relieved. Thus, in several, stones were not removed from the gall-bladder, and the ducts were not even examined.† Yet these cases are published as successes.

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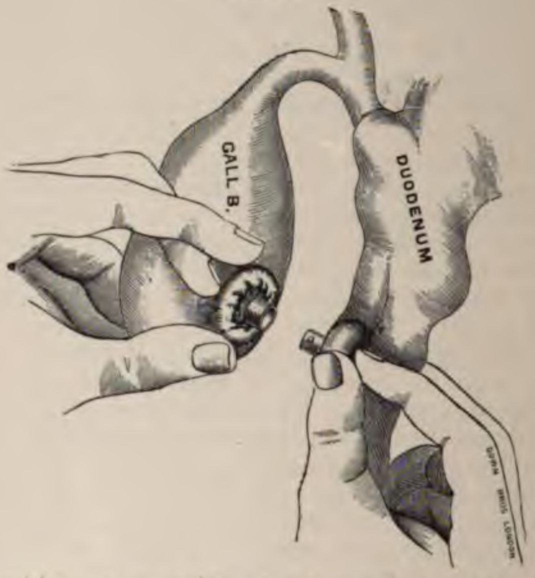
* Dr. Murphy, in a report up to 1897, gives sixty-seven cases of cholecystenterostomy for non-malignant obstructive jaundice, with only three deaths.

† Dr. McGraw, of Detroit, and Dr. Elliot, of Boston, both bring a further objection against the button consequent on this, that it often leaves behind it in the form of a stone or stones, sources of irritation, which may develop later into conditions of danger. Time must show, with careful watching and accurate reporting of cases, how far this criticism is justified.

As this operation, rendered so simple by Murphy's button, is likely to be resorted to in cases of stone impacted in the three bile ducts, it is right to point out that modern methods and recent experience have rendered removal of stones by incision so safe in skilled hands that this step, choledochotomy, is always to be preferred, when possible, to cholecystenterostomy. In other words, those of Dr. McGraw (*Ann. of Surg.*, Aug. 1895, p. 169) "we should try not only to relieve, but also to cure." (2) Another objection, though, I believe only proved by one case as yet, is that of septic infection of the ducts and liver from the intestine. We must remember how very different are the conditions after cholecystenterostomy, to those in health, as regards a communication between the intestine and the biliary passages. That a patient after this operation, as long as the opening remains free, must be menaced with the danger of septic infection is proved by a case reported by Rickard (*Bull. Soc. Chir.*, t. xx. 1894, p. 572). Here death occurred fifty-three days after cholecystenterostomy, although the patient did well at first. The necropsy showed that death was due to infection of the biliary passages from the intestine, numerous abscesses due to ascending infection being present. (3) There is the risk of contraction. Unless the opening is made very free, this may set in after any method. (4) Hæmorrhage. This risk must be present, however cholecystenterostomy is performed, in cases of obstruction from malignant disease, owing to the tendency to hæmorrhage in these cases; it is especially likely to follow the use of Murphy's button, whenever a thickened condition or friability of the tissues prevents the button taking that grip which is so essential for success. All surgeons

FIG. 157.



Cholecystenterostomy with Murphy's button. (Down's Pamphlet.)

owe much to Dr. F. C. Shepherd, of Montreal, for the candid way in which he has drawn their attention to this fact (*Ann. of Surg.*, May 1893, p. 581):

His patient, aged 36, had a biliary fistula resulting from a previous cholecystostomy for jaundice, pain, &c., performed four months previously, when no stone was found. Owing to the annoyance of the continual discharge of bile, the abdomen was opened again by an incision internal to the old fistula, and a mass of malignant disease was now found involving the pancreas and duodenum. It was decided to unite the gall-bladder with the colon instead of the duodenum, "as being easier and more rapid, and quite as beneficial." The button was introduced without very much difficulty, the purse-string suture being first inserted. Owing to the thickness,* of the gall-bladder there was some puckering, and the parts did not come together without considerable pressure on the button. On dropping back the bowel and gall-bladder with the button there was no tension, and the parts seemed to be in accurate apposition, and to lie comfortably. It was decided not to close the fistulous opening, as it was felt that this would close of itself. On the morning of the fourth day (the patient having gone on well in the interval) blood was found to be oozing from the gall-bladder and the abdominal wound. In spite of gauze-packing this continued, and the patient passed into a state of collapse. On opening the abdominal wound it was seen that the hæmorrhage came entirely from the gall-bladder. The button had cut through the thick and friable walls, and could be easily seen. To remove the button it was necessary to incise both gall-bladder and bowel and unscrew the button. It being useless to reinsert the button, it was decided to sew up the openings in the gall-bladder and colon. A fresh oozing took place about twenty-four hours later, and the patient sank. A partial necropsy showed that the obstruction of the common duct was due to malignant disease of the head of the pancreas.

Küster (*Verhandl. d. Deut. Gesellsch. f. Chir.*, April 1861), reports a case in which two stones had been removed by incision of the dilated common duct, the opening being closed by a double row of sutures. Gauze-drainage was employed. Eleven days after the operation, hæmorrhage took place from the drain-tract, this was arrested by the thermo-cautery, and fresh packing with iodoform gauze. The patient recovered, and a year later passed two stones.

(5) The button may not be passed. This happened in a case of Dr. Briddon's (*New York Surg. Soc.*, 1896). Here the bladder was dilated with non-contractile walls. The button probably fell into this viscus as the larger chamber, and there remained, two months later, without causing inconvenience. Two other objections are brought against cholecystenterostomy by Dr. McGraw. (6) It produces adhesions between previously detached organs, adhesions which may interfere with their movements and with their actions. (7) After this operation the bile is diverted through the cystic duct and gall-bladder into the bowel. The gall-bladder takes on itself the function of the common duct, and the common duct, remaining patulous at its upper end, receives a certain amount of bile which stagnates under conditions which favour its crystallisation, especially if, as is often the case, the common duct already contains stones.†

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* It will be noticed that no mention is made of the gall-bladder being friable, the condition which was found, a little later, to have contributed so largely to the fatal result.

† "Here then we have the beginning of a morbid condition of which no man can foresee the end. There is no reason why, in the course of time, the obstructed duct may not become full to overflow with numberless gall-stones which could not fall in this receptacle to cause fully as much disturbance as in the gall-bladder itself." Only careful watching of cases can prove whether the above criticisms are true. Those surgeons who are familiar with Dr. McGraw's work will feel with me that they cannot be lightly passed over.

Of the three methods above mentioned, however, that by means of Murphy's button, in spite of the above objections, is certainly the best to adopt on account of its rapidity and efficiency as shown by the results given above. Moreover, Mr. M. Robson has now himself discarded his bobbin for the Murphy button, which he has used fifteen times with three deaths. The operation itself is similar to others in which the button is employed, and does not require any special description.

CHOLECYSTECTOMY.

The indications for this operation as given by Mayo Robson (*loc. supra cit.*) are as follows: "(1) In bullet wound or other wound of the gall-bladder where suture is impracticable. (2) In phlegmonous cholecystitis. (3) In gangrene of the gall-bladder. (4) In multiple, or in perforating ulcers. (5) In chronic cholecystitis from gall-stones, where the gall-bladder is shrunken and too small to safely drain, and where the common duct is free from obstruction. (6) In mucous fistula due to stricture of the cystic duct. (7) In hydrops of the gall-bladder due to stricture of the cystic duct; as also in certain cases where the gall-bladder is very much dilated. (8) In certain cases of empyema, where the walls of the gall-bladder are very seriously damaged. (9) In cancer of the gall-bladder."

Operation.—Sufficient room having been provided by a free longitudinal incision prolonged laterally along the costal margin towards the middle line, or by a free transverse or semilunar incision (p. 354), the contents of the peritonæal sac are shut off with flat sponges or tampons of sterile gauze before the adhesions of the gall-bladder are separated. These will vary greatly. In a normal case they will be simple, and all that is needful is to divide the reflexion of peritonæum which passes from the liver over the gall-bladder, and then to shell out the latter from its fossa by gently tearing through the connective tissue and vessels which hold it in place, with the finger or a pair of curved scissors, these being used as a blunt dissector as well as to cut with. In cases, on the other hand, where there is much matting of the parts, the omentum, duodenum, colon, pylorus may all require most careful detachment, bit by bit, before the gall-bladder is reached, lying far from the surface, puckered and shrunken. And when this is effected, repeated attacks of inflammation may have converted its immediate surroundings into a compartment of sclerosed fibro-fatty tissue out of which it has to be shelled like a kidney, the site of long-standing calculous pyelitis, from out of its thickened, matted cupsule. Friability of the walls of the gall-bladder, these tearing away on the slightest traction, is another difficulty which may be very present with a deep-lying viscus. The gall-bladder having been separated as far back as the cystic duct, the first part of this is isolated, and its distal extremity tied with sufficiently stout sterilised silk. Two ligatures should be tied and an aneurysm-needle may be useful here. Care must be taken not to include the hepatic, and still more the common duct, in cases where the depth of the wound and adhesions may make the relations of parts uncertain. Before severing the duct it will be well, if two ligatures have not been passed, to close its proximal end with clamp forceps so that no bile escapes when it is divided. Any mucous membrane which projects from the cut end should be treated with a little pure carbolic acid, or it may be treated like the stump of an appendix by drawing the cut edges of the serous coat together by one or two stitches of fine catgut.

The bleeding, chiefly of the nature of oozing, usually yields to well-applied pressure; any bleeding points which cannot be tied off must be treated, as in all operations on the bile-passages which present a like difficulty, by leaving on Spencer Wells's forceps for twenty-four or thirty hours, a step which will also facilitate drainage.* The parietal wound will usually be only closed above, as in most cases, owing to some uncertainty as to the perviousness of the ducts below, or bleeding from adhesions, it will be well to employ drainage together with gauze packing.

Treatment of Biliary Fistula.—This most troublesome affection usually follows on cholecystostomies. It has already been alluded to, but owing to its importance and the difficulties which surround it, a few more words are required. If of any duration it depends, usually, upon one or two causes—a stone impacted in the common duct, or malignant disease of the head of the pancreas. The annoyance from the constant discharge, the difficulty of collecting this, the frequent change of dressings necessitated when the patient is about, the eczema and rawness around the wound, are very great. In the case of an impacted stone, if it cannot be felt and removed or dislodged by manipulations from the adherent gall-bladder, the abdomen should be freely opened by an incision to the inner side of the fistula, exposing the gall-bladder adherent to the parietes; the ducts are then examined and the stone localised in the common duct, and either broken up, or pushed on or removed by incision. If the above course is really impracticable, cholecystenterostomy must be performed. In the very rare cases where the obstruction is due to contraction which has set in after ulceration due to the long-continued pressure of a stone, the surgeon should try to open up the duct with probes and sounds passed from an opening in the gall-bladder, aided by a finger within the peritonæal sac. Where it is found that malignant disease is the cause of the obstruction, if this be in an early stage (p. 365), the patient's power of repair good, and the blood not yet seriously altered, cholecystenterostomy should be performed.

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* If oozing from the liver substance is not checked by efficient and prolonged sponge pressure, tamponnading with iodoform gauze or the thermo-cautery must be employed.

CHAPTER X.

OPERATIONS ON THE PANCREAS.

TREATMENT OF PANCREATIC CYSTS.—ACUTE PANCREATITIS.

TREATMENT OF PANCREATIC CYSTS.

Diagnosis of Pancreatic Cysts.—Sufficient cases have been published to make the following probably reliable:—The swelling, which may date to an accident, appears, usually in an adult, in the epigastric region, is generally accompanied (especially when its increase is rapid) by "cœliac neuralgia"—*i.e.*, pains probably arising in the solar plexus—often colicky, or even agonising, and leading to collapse. Dyspepsia, marasmus, and mental depression are often present to a marked degree. The position of the cyst, behind the stomach and transverse colon, and the chemical and microscopical examination of the fluid are well worthy of attention.

Treatment.—Dr. Senn showed that the wisest course was incision of the cyst by abdominal section. The results of attempting to extirpate the cyst have been so unsuccessful as to entirely justify his condemnation of this course.

The following case,* in which I operated at the request of Dr. Newton Pitt, is a good instance of a pancreatic cyst treated by laparotomy, incision, and drainage:—

I received the following history when asked to see the case, August 21, 1889: The patient was 21. He had received a kick in the abdomen three years before, which had confined him to bed for three weeks. Ever since he had been liable to severe attacks of epigastric pain. He had been markedly jaundiced, was emaciated, and suffered a good deal from nausea and depression. The swelling in the epigastric region was convex and uniform, and reached from below the tip of the ensiform cartilage to just above the umbilicus, and laterally to near the ends of the eleventh ribs. The tumour gave the impression of being attached to some deep-seated structure. There was transmitted impulse synchronous with the pulse, but not expansile. As the swelling had refilled after two previous tappings,† and, as the swelling and the patient's distress were steadily increasing, laparotomy was performed, August 22, with strict antiseptic precautions. An incision, three inches long, was made over the most prominent part of the cyst, an inch and a half to the left of the middle line, extending to within an inch of the umbilicus. The parietal peritonæum having been stitched to the margins of the wound, the lower edge of the liver could be seen moving with respiration in the upper angle, while the rest of the incision was occupied by a smooth reddish surface, which bulged strongly forwards. Taking this to be the front of the cyst, and having ascertained before the operation that the cyst was dull on percussion, I was about to leave this, for twenty-four hours, to become adherent before it was incised. The result proved that, if I had done so, the scalpel would have passed through both walls of the stomach. Before dressing the wound, I again scrutinised the surface of the supposed cyst, and thought I found evidence of involuntary muscular fibre, which threw doubts upon the swelling being a pancreatic cyst. When the supposed cyst was examined between the fingers, it proved to be the empty stomach, stretched very tightly over the subjacent cyst. To get at this, the stomach was drawn upwards, that it might be packed away above under the liver. But here an embarrassing difficulty arose. As I pulled up the stomach, which was tightly jammed between the bulging cyst behind and the parietes in front, the omentum came up into the wound in front of the cyst. The tension of the parts was so great, owing to the rapid increase in the cyst, that there was no room above in which to pack away the omentum. Pushing this to either side, already fully occupied, pulled down the stomach again. I accordingly drew the greater part of the omentum out of the wound.* Some of it was tied with catgut, and cut away; much of it was left heaped up on the abdominal walls on either side of the incision. One or two fine catgut sutures retained the omentum in position. I next scratched through the two layers of omentum, and exposed the surface of the cyst for a space the size of a shilling. There was thus a somewhat conical passage leading from the abdominal incision, through a mass of omentum, down to the anterior surface of the cyst. This last was very vascular, and so tense that it was not thought advisable to put in a guide-suture. The patient passed through the next twenty-four hours fairly well. At midnight, August 23, symptoms of collapse set in (hæmorrhage probably took place at this time into the cyst, a complication which must always be probable, owing to the very vascular surroundings). The patient's pulse at 2 A.M. had run up to 163, and his condition pointed to a fatal ending at no distant date. At 3 A.M. I passed a fine trocar into the cyst, and drew off 12 oz. of deeply blood-stained fluid, which was under very high tension. The sac was then incised and a large drainage-tube inserted. A marked improvement at once set in. A slight discharge of dark treacly fluid necessitated changing the dressing twice a day at first. The wound was all healed in two months (*vide infra*).

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* My colleague and I reported this case fully (*Trans. Med.-Chir. Soc.*, vol. lxxi p. 455). References are given to thirty cases which will be found summarised there by Dr. Pitt. References are also made to thirteen cases by Mr. Cathcart in his instructive paper (*Edin. Med. Journ.*, July 1890).

† The fluid was alkaline, sage-green, sp. gr. 1013, albuminous, and, under the microscope, showing innumerable collections of globular masses of tyrosin crystals. No

On another occasion I should prefer to open the cyst at once either by a large trocar and tubing, or by a small incision, keeping the cyst well forwards by means of Spencer Wells's forceps attached to the cut edges. Then, as the cyst emptied, a finger as a guide having been introduced into the cyst and pushed downwards and outwards below the left infra-costal margin, a counter-opening might be made and a large drainage-tube inserted into the cyst from behind. This would be

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leucin could be detected. The fluid in these cysts varies a good deal—sometimes colourless and serous, at others it is red and viscid. It will be seen from the account that follows that on each occasion the aspirating needle must have transfixed the stomach. The same thing, with like harmlessness, happened in one of Karewsky's two cases (*Deut. Med. Woch.*, No. 46, 1890). In two cases the preliminary puncture was followed by evidence of peritonitis, and in two by grave collapse attending the escape of fluid from the cyst into the peritonæal sac. Another possible danger is puncture of the transverse colon, which may be tightly stretched over the cyst. If fluctuation can be detected in the infra-costal region behind, or if a thrill can be obtained here from the front, it will be safer to aspirate from behind.

* On another occasion I should divide the omentum above the transverse colon.

shortened from time to time, as gradual contraction of the cyst took place. The anterior opening in the cyst could be either sutured, or attached to the margins of the abdominal incision. Mr. Cathcart left the opening in the front of the cyst open, Mr. A. P. Gould closed his by suture.

Mr. Caird (*Ed. Med. Journ.*, Feb. 1896) acting on Mr. Cathcart's plan of making a counter-opening behind, opened one of these cysts at the back, and not through the anterior abdominal wall, as is usually done. The incision was made along the outer border of the erector spinæ just below the twelfth rib, and a tube inserted. This was kept in for four months, and later on iodine was injected occasionally to promote obliteration of the cyst. The patient was ultimately discharged, with the opening closed. The administration of liquor pancreaticus with the food was thought to have been beneficial. All will agree with what Mr. Cathcart claims for the posterior incision, viz., (1) that the cyst can here be reached extra-peritonæally; (2) that this incision gives better drainage; and (3) that by it there is less risk of a ventral hernia.

The after-history of any case of pancreatic cyst reported as cured by drainage must be carefully watched. It is clear that under certain conditions—*e.g.*, where the cyst is very large, where it has thick walls. and above all where the duct communicates with the cyst and where much of the tissue of the pancreas remains—recurrence is almost certain and complete obliteration by drainage probably impossible. As in most of these cases the intimate relation of these cysts with very vital parts does not admit of their being dissected out, we must be prepared to fail sometimes in our efforts to secure a radical cure. This is shown by the sequel to Dr. Newton Pitt's and my case, which was brought as one treated successfully by drainage, before the Medico-Chirurgical Society (*vide supra*). About a year later I heard that the swelling had reappeared and that the man was about to be operated on again. Later on I was given to understand that the swelling had reappeared a second time, but I have been unable to obtain the needful information. Dr. M. H. Richardson, of Boston, drew attention to this tendency of pancreatic cysts to recur after drainage. "Pancreatic Cysts apparently cured by Incision and Drainage; Recurrence; Perforation of the Stomach; Death; Autopsy" (*Boston Med. and Surg. Journ.*, vol. cxxvi. 1892, p. 441). At the necropsy it was found that the head of the pancreas was normal, and that a tube could be passed from the pancreatic duct into the cyst; about two inches of normal pancreatic tissue were found lying between the cyst and the spleen. From this also a duct could be traced into the cyst. It was very difficult and even impossible at the time of the necropsy to dissect out the cyst from the parts to which it was adherent. Dr. Richardson thinks that in some cases the permanent use of a tube will be needful. Mr. A. P. Gould published (*Lancet*, vol. ii. 1891, p. 290) a case of pancreatic cyst which had been treated by drainage, a sinus persisted in spite of treatment, and, three years later. became the site of epitheliomatous infiltration. Dr. O. Ramsey, of Baltimore, in a case of a large pancreatic cyst treated by drainage, was obliged to continue the use of a drainage-tube seven months after the operation, as the discharge was still free (*Ann. of Surg.*, Dec. 1895). Dr. Ramsey thinks that in addition to persistence of secretion the large size of the cyst and the tension under which the fluid escapes when the cyst is opened, point to gland substance being present and still functionally active. The last two features, it will be noticed, were present in Dr. N. Pitt's and my case, which recurred after an apparent cure.

ACUTE PANCREATITIS.'

The first accurate account of this rare disease was given by Fitz (*New York Med. Record*, 1889). Since then a number of cases, about forty in all, have been recorded by various observers.

The chief symptoms, as summarised by Fitz, are:—"Sudden, severe, often intense epigastric pain, without obvious cause, in most cases followed by nausea, vomiting, sensitiveness, and tympanitic swelling of the epigastrium. There is prostration, often extreme, frequent collapse, low fever, and a feeble pulse. Obstinate constipation for several days is the rule, but diarrhœa sometimes occurs. If the case does not end fatally in the course of a few days, recovery is possible, or a recurrence of the symptoms in a milder form takes place, and the characteristics of a subacute peritonitis are developed."

Very few of the cases have been correctly diagnosed, the majority, as will be readily understood by consideration of the above-mentioned symptoms, having been thought to be either acute peritonitis or acute intestinal obstruction, usually the latter.

In a few instances the presence of an epigastric tumour has materially aided the diagnosis; such cases have been recorded by Thayer (*Amer. Journ. of Med. Sci.*, vol. cx.), Pitt (*Clin. Soc. Trans.*, vol. xxxii.), and others. In Thayer's case, abdominal section revealed the presence of an abscess in connection with the pancreas, drainage of which resulted in recovery. In Dr. Pitt's case, the tumour was chiefly due to blood effusion in and around the pancreas.

Treatment.—The uncertainty of the diagnosis, or the fact that acute pancreatitis was unsuspected, has led, in the majority of cases, to the performance of an exploratory laparotomy. Should such an operation be performed on a patient supposed to be suffering from either acute intestinal obstruction or acute peritonitis with a negative result, the possibility of acute pancreatitis must be considered. The following points will be found useful under such circumstances:

(1) *Fat-necrosis* may be present. This occurs in the form of small patches, circular or oval in shape, and of an opaque white or yellow appearance, scattered about the fat over the pancreas, the omentum and the mesentery. If, on careful inspection with a good light, evidence of fat-necrosis is found, it may be inferred that some serious lesion of the pancreas is present. Absence of fat-necrosis, on the other hand, does not exclude the possibility of acute pancreatitis.

(2) *Swelling of the Pancreas on Palpation.*—This may be due to inflammatory exudation, blood effusions, or a collection of pus. In order to further examine the pancreas, it must be approached either through the small or great omentum, whichever is found to be the more convenient.

If a diagnosis of acute pancreatitis is made either before or after exploratory laparotomy, the further treatment will depend upon the particular condition of the pancreas that is found to be present.

Should an abscess be present, this must be opened and drained. Mr. Mayo Robson (*Brit. Med. Journ.*, May 11, 1901) recommends a vertical posterior incision in the left costo-vertebral angle for this purpose. Such an incision would certainly be more favourably placed for the purposes of drainage; great care, however, would have to be exercised in carrying out this plan in view of the important structures which might be injured.

If it is decided not to make an opening behind, the abscess must be packed with iodoform gauze and drained through the anterior incision.

If hæmorrhage in and around the pancreas is found, clots may be rapidly removed and the cavity packed with tampons of iodoform gauze.

Owing to the extremely serious condition that the patient is usually in, every possible precaution must be taken to avoid shock, and the operation itself must be performed as rapidly as possible.

CHAPTER XI.

OPERATIONS ON THE BLADDER.

MOVAL OF GROWTHS OF THE BLADDER.—OPERATIVE TREATMENT OF TUBERCULAR ULCERATION.—PARTIAL PROSTATECTOMY. — LATERAL LITHOTOMY. — SUPRA-PUBIC LITHOTOMY.—MEDIAN LITHOTOMY.—LITHOTRITY AND LITHOLAPAXY.—PERINÆAL LITHOTRITY. —REMOVAL OF STONE IN THE FEMALE.—CYSTOTOMY. RUPTURED BLADDER.

REMOVAL OF GROWTHS OF THE BLADDER.

actical Points in the Diagnosis.—Early and accurate diagnosis is re of the utmost importance.

I. *Hæmorrhage.*—This is of much importance, both in diagnosis and bearing upon an operation. Thus, in the villous growth or fimbriated pilloma it is this alone which kills. Again, it may be the only mptom. In these growths the chief point is that the hæmorrhage tends over a long time,* occurs spontaneously and suddenly, and thout any allied symptoms; it ceases in the same way; the riods of intermission gradually become less, till the bleeding is con-ant, either rendering the patients utterly anæmic or adding to their sery by bringing about cystitis. These two last conditions may be so rked as to demand an operation. This symptom is most frequent in e villous growth (fimbriated papilloma),† less so in the fibro-papilloma

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Mr. R. Harrison (*Intern. Encyl. Surg.*, vol. vi. p. 38) states that in the Museum of George's Hospital there is a specimen of a villous tumour attached to the neck of bladder of a gentleman aged 81. The first attack of hæmorrhage had occurred nty years before death, and had lasted for eight months. An interval of four years followed this, and then a recurrence of hæmorrhage, which ultimately proved l. Sir B. Brodie also states that the disease occasionally extends over seven or eight rs. In a case of the late Mr. W. Anderson's (*Clin. Soc. Trans.*, vol. xviii. p. 313), of illoma, the first hæmaturia had taken place twelve years before, then came an erval of a year, followed by recurrence of the hæmaturia, the next interval being rtened to six months, after which recurrence took place fairly regularly every three nths.

The following classification is that given by Prof. Küster in Volkmann's Clinical tures:—A. New growths of the prostate—1. Fibro-adenoma; 2. Myxoma; 3. Car-oma. B. New growths of the bladder—i. New growths from the mucous or sub-

or in the "transitional" growths. Sir H. Thompson lays much stress on the fact that, in these cases, the stream often begins without any or with little blood, and ends of a bright-red colour. Again, if the bladder be washed out with an antiseptic lotion (p. 401), this becomes deeply coloured after a momentary stay within the viscus.

II. *Sounding.*—This is usually said to be negative, but it should be made use of thoroughly and carefully. In the case of a single, fimbriated papilloma, the sound may give no information unless it happen to detach a portion of the growth. In more solid growths—*e.g.*, a fibrous papilloma, a transitional or sarcomatous tumour—irregularity or resistance may often be met with at one spot in moving the sound. For instance, it may be easy to explore one side of the bladder by carrying the sound over to the opposite thigh, while similar manœuvres to examine the other side are interfered with. In the mucous polypi of children any movements of the sound may be prevented, and carcinomata, if ulcerated, may give a very distinct, uneven, rugged feel, while the increase of pain afterwards is here very marked. But sounding is of value beyond what it tells at the time. By using the sound with judicious and gentle vigour, particles of a villous growth may be detached for microscopical examination. This may perhaps be aided by washing out with a lithotrity-evacuator, as suggested by Mr. Davies-Colley. Several surgeons, I amongst the number, have had cases in which a catheter with a large eye has entangled and detached, as the bladder emptied, processes of the growth. Additional knowledge may be gained by the sensation sometimes given by the catheter as if it were moving against wet wool or sponge, or through delicate seaweed. Every precaution must be taken not to cause cystitis or to set up bleeding by the use of the catheter. If the latter follow, the bladder should be opened without delay. M. Guyon (*Ann. de Mal. des Org. Gén.-Urin.*, 1889, p. 449) points out that in a few cases a pedunculated growth situated near the neck may cause obstruction and other micturition troubles, before hæmorrhage appears.

III. *Examination of Urine.*—This aid has been too much neglected because the naturally present "transitional" epithelium of the bladder may so easily be mistaken for growth cells. But, in the case of villous growths especially, careful examination of the urine should be frequently made, and the patients directed to bring, at once, any white or shreddy particles passed. The sediment of the urine should be also frequently examined microscopically after sounding and washing out the bladder. The delicate papillæ, with their connective-tissue basis supporting hosts of columnar cells with large delicate capillaries, are most characteristic.

IV. *The Cystoscope.*—In certain obscure cases, as where a growth is present for some time without causing bleeding, this instrument will be of much service. But it must not be forgotten that its use entails certain disadvantages. Thus, very easy to use in the bladder of women, in men it is a very different matter. Here, in the deep urethra, it may

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mucous coat 1. Papilloma (including the two varieties of Sir H. Thompson), viz.: (α) Fibriated papilloma or villous growth; (β) fibro-papilloma. Sir H. Thompson has also described a transitional form of papilloma, characterised by vascularity and cell-infiltration. 2. Fibrous polypi and myxoma; 3. Sarcoma. ii. New growths from the muscular coat: 4. Myoma. iii. New growths from the epithelial and glandular tissues: 5. Adenoma. 6. Carcinoma. 7. Dermoid cyst.

excite bleeding, or it may cause grave febrile disturbance; one case has been related to me, in which difficulty of manipulating it through the prostatic urethra was followed by fatal injury to this part. Such cases are not published.

V. *Cystotomy.*—The cystoscope can help us as to the size and site of the growth—but whether it is simple or malignant,[*] whether it is merely implanted on the mucous membrane or infiltrating, can only be told by cystotomy, and not always by this. I strongly advise a more extended use of supra-pubic cystotomy to explore and clear up the diagnosis in these cases. Where nothing further is done much of the risk of the operation will be removed by immediate suture of the bladder, which will admit of antiseptic precautions being thoroughly carried out.

VI. *Dilatation of Urethra.*—This should always be made use of in a female patient. It is invaluable in clearing up the case, and the incontinence left is slight and of brief duration. *Exploration* by perinæal incision. This, if the perinæum is not very deep, the prostate not much enlarged, and if the growth is not very far from the neck of the bladder,[†] may give useful information, but it is not, in my opinion, equal to opening the bladder above the pubes and closing the incision by suture, if nothing more is done. The supra-pubic incision is to be advised in every case. The vaginal incision again, or colpo-cystotomy is not to be relied upon for sufficient room: moreover, if the edges are bruised, it runs the risk of leaving the patient with a most odious fistula.

VII. *Exclusion of other Conditions*—*e.g.*, stone, tubercular and other forms of cystitis, also hæmorrhage from the prostate or kidney. In none of these cases, save in the last, is there the spontaneous character which often marks the bleeding of bladder growths. In renal hæmaturia due to growth the bleeding may be spontaneous, and unaccompanied by other evidence. Here the renal region should be thoroughly examined at regular intervals. In tubercular disease of the bladder the bleeding is never as severe as in growth, and for a long time occurs with the end of micturition. Other evidence will also be present, and so too with the hæmorrhage of enlarged prostate, which will very likely be preceded by a chill or by retention.

Indications for Operation.—Growths of the bladder being inevitably fatal, whether from hæmorrhage, or pain, or the results of obstruction, or from these combined, the surgeon is entirely justified in urging an early digital exploration to clear up the case and the question of removal. This may be supra-pubic cystotomy, with immediate suture if nothing more is done, or dilatation of the urethra in a female subject. While it remains as yet uncertain how many of the cases published as cures are really and permanently so, even in the case of the villous growth, it is an undoubted fact that an operation may result in arresting the hæmorrhage completely for years. In other cases, hæmorrhage, pain, and frequency of micturition may all be very largely relieved. Where little or nothing can be done in the way of removal, the free escape given to the urine by a perinæal or supra-pubic operation or by dilating the neck of the bladder in a woman may give great relief; where even this fails, the diagnosis has, at least, been cleared up.

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[*] It is always worth while to remember the vast preponderance of malignant over benign growths of the bladder (Wallace, *Edin. Med. Journ.*, 1893, p. 735). Thus, out of eighty-eight cases which Albarran personally examined, seventy-one were malignant and seventeen simple. Out of twenty-two cases Guyon found nineteen to be malignant.

[†] If the growth be a very soft one it will be found very difficult to determine by the perinæal route which is growth and which is bladder. By the supra-pubic opening the eye will determine this.

If in doubt as to recommending exploration, the practitioner should remember: (1) That the long intervals between the bleedings teach strongly that growths of the bladder often pass through a long first stage, during which the growth is connected with the mucous membrane only; (2) That, following on the above, infiltration of the deeper coats, and thus glandular infection, is often here long delayed. While the long intervals between the bleedings, and the comparative slightness of the other symptoms, may make the surgeon unwilling to urge operative interference, it is right that it should be very clearly put before the patient that it is in this stage only that any hope of a radical cure can be given, and that later on, when the stage of infiltration is reached, not only is radical cure almost out of the question, but the risk of attempting it and so of perforating the coats is vastly increased. The points that a supra-pubic exploration will clear up about the growth are the number, site, whether accessible or not, and its relation to the ureter, how far pedunculated or sessile, how far it seems attached to the coats of the bladder. There is a general belief, I think, that pedunculated growths are usually benign. This is a very dangerous belief. Malignant growths or transitional ones becoming malignant form the very great majority of bladder growths. If the growth is at all thick or succulent, if it is at all infiltrating—*i.e.*, not a merely implanted pedicle—the odds are greatly in favour of recurrence, however thoroughly the growth is removed. Of twenty-eight cases of pedunculated growths examined by Albarran fifteen were malignant. In apparently simple cases recurrence may take place in spite of the most complete operation (*ibid.*). The more the growth approximates the worst of all types of bladder growth—*viz.*, the low-lying, broad-based, fixed, sessile lump, especially if with a sloughy surface incrusted with phosphatic *débris*, the more hopeless is operative interference.

Choice of Operation.—In my opinion, in all cases, but especially where the surgeon is uncertain as to the size or the number of growths, where the perinæum is very deep, where the prostate is enlarged, or the perinæum small and the pelvic outlet contracted, the supra-pubic method will be safest and give most room. So, too, in the case of a recurrent growth, this method should be employed, as it cannot be told how far the recurrence is widely diffused. The supra-pubic operation is always to be preferred as enabling one to see as well as to touch the growth, as alone giving more room for necessary manipulations, *e.g.*, the use of an electric lamp in what may be a very difficult operation.*

Only when there is strong reason to believe that the growth is single, or small, and near the neck, may the bladder be explored from the perinæum by opening the membranous urethra, and dilating the vesical neck. But even here I do not recommend it.

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* It is noteworthy that all the surgeons of widest experience have declared for the supra-pubic method—viz., Sir H. Thompson, Guyon, Volkmann, Dittel, von Antal, &c.

In some cases it will be advisable to combine both operations, as the perinæal opening enables the surgeon to use two index-fingers in the bladder at the same time, and also favours drainage, especially where the urine is foul.

In cases where, owing to complete removal having been an impossibility, it is desired to give relief by a permanent opening, a supra-pubic one kept patent by a short curved tube and plate (somewhat like a tracheotomy-tube) will be preferable to a perinæal opening, owing to the tendency of the latter to close.

Operation.—If the surgeon decide to first open the membranous urethra for purposes of exploration or to ensure drainage he does so in the manner of a median lithotomy (p. 406), and explores the bladder after dilating the neck with his finger, which is made to enter by a careful insinuating movement along the director, which is then withdrawn. If no growth is felt near the neck, the surgeon, rising, makes firm supra-pubic pressure, so as to bring the upper part of the bladder into contact with his left index.

Usually the surgeon determines to make a supra-pubic opening at once, for the reasons already given. In order to secure the maximum elevation of the base of the bladder a rectal bag (p. 400) should be used here. The bladder is then distended, either through the penis, or through the perinæal wound by a large catheter, this wound being finally plugged around the catheter with iodoform gauze, aided, if needful, by digital pressure exerted by an assistant. The supra-pubic opening is then made with the precautions given at p. 402; when the bladder is distinctly reached, some advise that one or two sutures of carbolised silk be passed across the site of the intended opening into the bladder with a curved needle in a handle. The opening into the bladder is then made (carefully, so as not to divide the underlying silk), and the silk is hooked up and divided; by this means two or four sutures are present, which will serve to raise up the bladder as required, and to keep it well open and within reach during the manipulations required for the removal of the tumour.* I prefer the use of two Spencer Wells's forceps on either lip of the wound, held by assistants; the threads when pulled upon being liable to tear the delicate tissue of the bladder. The slight bruising inflicted by the forceps is not of importance, as all the opening will not be sutured.

In opening out and exposing the cavity of the bladder specula† of wire (solid-bladed ones taking up too much room) will be found very useful, but the need of these and other rarely used and expensive instruments will be less felt if an electric lamp is at hand.

The removal of the growth is effected in different ways, according to its structure. Sharp spoons, curettes, appropriate forceps, straight, and of different curves (Fig. 158), Jessop's prostatectomy forceps, those with serrated blades introduced by Sir H. Thompson, Paquelin's cautery, and a small écraseur with a violin-string ligature, should be at hand.* When a growth has a sufficiently long pedicle, it should be dragged up and twisted or cut away a little above its attachment to the mucous membrane. This and the adjacent mucous membrane† must then be deliberately removed with blunt-pointed scissors. If the cut edges can be united by catgut sutures, so much the better; if not, the wound must be left to granulate.

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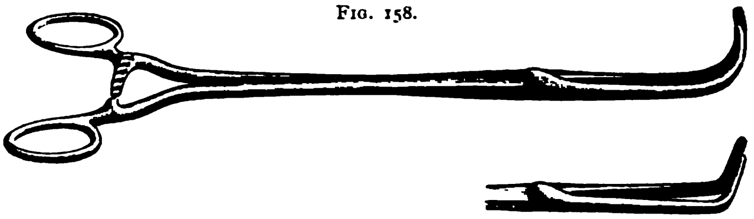
* In difficult cases the position of Trendelenberg (p. 387) is always to be employed. The intestines gravitating towards the diaphragm drag upwards the peritonæum and thus the bladder slightly. The deeper parts of the viscus can now be better brought into view, especially with an electric lamp.

† Of these special instruments the bladder-speculum with two wire blades invented by Watson of Boston (*Lancet*, Oct. 18, 1890) and the three-jawed speculum of Bruce Clarke (*Brit. Med. Journ.*, July 4, 1891) are the best.

In more doubtful cases—cases transitional between innocent and malignant—the following test of Albarran's may be useful: "The gliding or otherwise of the mucous membrane ought to regulate the depth of the removal of the growth; wherever the mucous membrane seems fixed to the sub-mucous coat it would be better, even in pedunculated growths, to resect the entire wall, a step still more essential in small sessile tumours" (*vide infra,* Partial Resection of the Bladder, (p. 383). When the growth is of firmer consistence and more of the sessile type, it should be clipped away with scissors, punched out (if firm) bit by bit with Jessop's prostatectomy forceps, scraped down with the nail or curette, or partly nibbled, partly twisted out, by Sir H. Thompson's serrated forceps.‡ This surgeon thus describes the use of the forceps:

Fig. 158.



Useful forceps for twisting away of bladder growths or hypertrophied prostate tissue. (R. Harrison.)

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* The galvanic écraseur should never be used unless other instruments have failed. The loop will, no doubt, shear away, without hæmorrhage, large masses which, from their size, poorly marked pedicles, and vascularity, are very difficult to deal with otherwise. But its liability to introduce septic complications, and the difficulty of manipulation in a deep contracted space, are grave objections to the cautery. If the surgeon is driven to use an écraseur, he should employ the ordinary wire one, on account of the above-mentioned septic complications. Mr. Bryant (*Lancet*, 1886, vol. ii. p. 1076) found the following method useful in the case of a bladder which appeared to be filled with villous growth: A great deal having been removed by forceps, the bladder was scraped throughout, the walls being wiped rather roughly with a new sponge tightly tied round a forceps. Hæmorrhage recurred six months later, persisting for a week; it then stopped, and the man was doing well eighteen months after the operation. Used in a similar case this method has been inefficient and followed by rapid recurrence.

† "Even in the most simple cases the removal of the growth should be more extensively performed than is the custom, and all the mucous membrane in contact with the growth should be removed. We have seen the possibility of infection by contact with the mucous membrane, and the plan I propose is to eradicate the epithelial neoplasms that may exist around the growth," Albarran (*loc. supra cit.*).

‡ Whatever method is used, the surface left should be as smooth as possible, in order to diminish the risk of phosphatic deposit.

Having, with his forefinger, first made himself familiar with the exact position and size of the tumour, the surgeon inserts the forceps, guided only by the knowledge thus acquired, and makes a decided snip on the tumour; then, by moving the forceps in different directions, he makes sure that he has the growth within their grasp. "Above all things, he is not to pull forcibly, but to press firmly the blades together, biting or chewing a little, if I may use the terms, with the extremities of the blades without changing the original situation of the bite or grasp. Then a little twisting movement may help to disengage the mass, which, if accomplished, the forceps will be felt free, and may be withdrawn with their contents, after which the finger enters to feel what remains and what more must be done in order to complete the removal. Let me remark, whenever the forceps has removed a portion, however small, the instrument should never be reintroduced until the finger has again examined the interior" (*Brit. Med. Journ.*, 1884, vol. i. p. 1240; *Tumours of the Bladder*, p. 80).

The same surgeon thus draws attention to the great risk of making strong supra-pubic pressure while forceps are being used through a perinæal wound: "If that pressure is considerable, it forces the upper wall of the bladder into its own cavity, and thus gives the growths a larger contour than they possess, and makes them apparently salient to a much greater extent than they really are. Thus, an eager or inexperienced operator, unaware of the effects of strong supra-pubic pressure, might be led to seize the mass offered to the forceps through the influence of this pressure, and, under the belief that it was a large growth, he might inflict a fatal wound by crushing a double fold of the coats of the bladder, and so make an opening in the peritonæum. To avoid such a catastrophe, it is only necessary, first, to decline the attempt to destroy any growth which is clearly not sufficiently salient to admit of complete or nearly complete removal; and, secondly, never to employ the forceps while forcible supra-pubic pressure is made—at least, no more pressure than is desirable just to steady and support the bladder and the parts adjacent."

When the mass of the growth has been removed by the nail, curette, or twisting-forceps, the base must be destroyed as effectually as possible by Paquelin's cautery,* or partial resection must be performed. Quiet nibbling and careful torsion will remove the bulk of the attachment of the growth, but if we are to progress in our surgery here, a radical cure can only be hoped for in growths that infiltrate the bladder wall by treating them as we do malignant disease elsewhere—*i.e.*, operating early and removing the whole thickness of the tissues affected, as long as this step is not foolhardy (see Partial Resection, p. 383). Finally, two warnings of Mr. Fenwick's must be remembered by those who trust to forceps and nibbling or twisting. "Munching the surface of a carcinoma and leaving the base is tantamount to an increase in the rapidity of its growth. I have reason to believe that the munching or squeezing of the healthy mucous membrane in the neighbourhood of the growth fosters the appearance subsequently of growth in the traumatised areas" (*Brit. Med. Journ.*, 1895, vol. ii. p. 906).

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* Though this method has the sanction of M. Guyon, it is only to be used in the case of large growths where partial resection is out of the question. Besides the inherent risk of sepsis it leaves a wound slow in healing, and a source of obstinate cystitis.

Hæmorrhage.—This must be met by sponge-pressure, occasionally ligature, or washing out with mercury perchloride solution, 1 in 6000, at a temperature unpleasantly hot for the hand. If it persists in spite of the above, and if the bleeding point is on the floor or above the neck, gauze tamponnading must be employed.

Two American surgeons, Dr. Keyes and Dr. Cabot, have made use of this successfully (*Med. Review*, Sept. 17, 1892). Bichloride gauze is cut into pieces, some twenty in number, these having sides six inches long on one aspect, three on the other, and four inches in the middle. In the centre of the three-inch, a small white shirt-button is attached, which securely transfixes the tampon, and has a long double piece of silk running away on the six-inch surface and a single piece on the three-inch one; a piece of silk is also attached to each of the four corners. The tampon is introduced thus: a soft catheter is passed into the bladder and out through the supra-pubic wound. The loop of double silk is then tied on to its end and thus drawn out at the meatus. The catheter being removed, traction on the silk draws the gauze down on to the bleeding surface, and the double silk loop is then tied at the meatus over a piece of gauze. If there be a perinæal wound, the silk is drawn through these incisions and tied tightly over a gauze perinæal pad. The removal of the tampon is effected by cutting the knotted silk and pulling on the five other pieces, the ends of which have been brought out of the supra-pubic wound.

When the operation is completed the question will arise as to the advisability of suturing the bladder. In the after-treatment of all supra-pubic cystotomies, the chief nuisance, and a very great one, is constant soakage of the dressings by the urine. This should be avoided whenever the following conditions make the use of sutures safe. (1) Efficient suturing, with silk or catgut. If the mucous membrane be stitched, a continuous suture of catgut must be employed, and a row of Lembert's sutures externally taking up the muscular coat only. (2) Efficient emptying of the bladder. (3) Arrest of bleeding, otherwise the catheter will be blocked, the distress great, and much tension will be thrown on the stitches. (4) An aseptic condition of the urine. (5) An operation in which the manipulations have not been very prolonged and difficult, and one especially in which there has not been much disturbance of the cavum Retzii. If the surgeon is wisely cautious about suturing the whole of the bladder wound, he will suture it almost completely, and leave in a small drainage-tube, putting in one or two provisional sutures which he will tighten up in a few days, when the risk of hæmorrhage and extravasation has passed away. When the conditions given above are not present, and suturing the bladder involves too much risk, the cut edges of the bladder should be united to those of the lower part of the parietal wound with catgut, and an india-rubber catheter, lengthened by a piece of drainage tube, passed along the urethra, and out at the supra-pubic wound. Several holes should be cut in the part that is to lie within the bladder. Bringing the tube out above the pubes facilitates washing out the bladder both ways.

If a catheter thus inserted does not drain, the only way to save the patient from the annoyance and risk of constant soakage of urine is to employ syphonage, a method more easily written of than efficiently secured.* Or a trial may be made of placing fine catheters within the ureters and bringing these out, inside tubes, through the supra-pubic wound.†

Partial Resection of the Bladder for Growths.—A few cases have been recorded with a sufficient amount of success to justify a repetition of the operation in selected cases. The growth must be situated somewhere in the upper or middle zones of the bladder. In cases where the growth is near the *bas-fond*, or in the vicinity of the ureter, resection is out of the question, and we must be content with careful erasion, with or without cauterisation at a red heat. Where the vertex or neighbourhood is the seat of the growth Antal's **extra-peritonæal method** should be followed. By this a large amount of the upper part of the bladder may be removed, but the farther the resection is carried the greater is the difficulty of stripping off the peritonæum, and, of course, in closing the gap.

The peritonæum is much more easily peeled off when the bladder is full than when it is empty. The edges of the wound in the bladder should be closed with silk sutures as completely as possible. When the resection has been so complete that the gap cannot be closed, its edges must be united to those of the parietal wound, and the opening closed later on by a plastic operation.

A good account of a case of resection of part of the lateral wall and disease of the bladder is given by Mr. H. Fenwick (*Clin. Soc. Trans.*, vol. xxvii. p. 164):

> The patient was a man aged 46. The growth, an epithelioma, had been removed twice before, the first time by the perinæal route, the second time supra-pubically, from a spot to the left of the orifice of the left ureter. "On opening the bladder supra-pubically, the growth was found to have recurred in the scar of the previous operation. It was now a smooth, sessile epithelioma, one inch and a half by one inch. The base was indurated, and the infiltration had involved the muscular and sub-mucous layers, for they were glued to the tumour. In order to gain free access to the left lateral wall of the bladder, I drew my knife horizontally through the left lower abdominal muscles, the incision commencing at the supra-pubic opening, and ending at a point above the inner third of Poupart's ligament. Stripping off the peritonæum from the front wall of the left pelvis, I kept it packed up with sponges. I then resected the growth by cutting away with scissors it and the entire thickness of that

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* The best means of draining the bladder is one described by my friend Mr. Cathcart, of Edinburgh (*Brit. Med. Journ.*, 1895, vol. ii. p. 968). Besides a douche-can, some india-rubber tubing and a pail, a screw-clamp, a small glass **Y** or **T** tube, a second piece of glass tubing bent like a capital **S**, and a third piece bent at a right angle to go into the bladder, are required. The can filled with water is fixed over the patient's bed, the **Y** tube is fastened with a large safety-pin to the edge of the mattress opposite the patient's pelvis. To one limb of the **Y** tube is attached about a foot of tubing which is connected with the can, to the other a right-angled glass tube, which dips into the bladder. To the stalk of the **Y** tube a third bit of tubing is attached which is fixed below to the **S** glass tube, which by means of another bit of tubing should end under some aseptic lotion. The apparatus being in position, the screw-clamp which controls the rubber tubing between the irrigator and one arm of the **Y** tube is then relaxed, so as to allow the water to run very slowly, in fact, only by drops. It accumulates in the **S** tube, and as it tends to run out produces a negative pressure in the other arm of the **Y** tube—*i.e.*, the one connected with the tube in the bladder, thus withdrawing the urine.

† Schede has thus kept a tube-catheter in one ureter for several days without any harm resulting.

part of the bladder which was subjacent to it. The bladder incision commenced at the median opening, and passed directly to the left until the upper margin of the growth was reached. It then proceeded round the tumour. The left side of the trigone was almost involved, but the ureteral orifice was not encroached upon. The hæmorrhage was not severe and was easily controlled by a couple of dozen Spencer Wells's forceps." The edges of the bladder wound were drawn together by catgut sutures which traversed only the muscular layers, a small supra-pubic opening being left for drainage. This wound and that in the abdominal wall healed quickly, and two years later (*Brit. Med. Journ.*, 1895, vol. ii. p. 907) Mr. Fenwick stated that the patient was at work in good health.

All will agree with the three conditions which Mr. Fenwick considers necessary before such operations are undertaken: (1) A single growth, slow and dense. (2) Absence of cystitis. (3) Sufficient *vis* on the part of the patient to bear so serious an operation.

If it is decided to attempt **intra-peritonæal resection**, as of a portion of the lower part of the bladder, the following directions of Albarran may be useful. A preliminary partial resection of the symphysis as advised by Helferich is first performed. The recti and pyramidales are detached above, and the external obturators below and externally; the periosteum is then carefully reflected, and sufficient of the bone removed by an osteotome and cutting forceps to expose the lower part of the bladder.* The bladder having been freely opened in front, and the escaping urine carefully removed with gauze sponges, the peritonæal sac is opened, and the intestines carefully packed away with sponges. We will suppose that it is decided to resect part of the trigone and *bas-fond* comprising one ureter. A bougie is passed into the ureter, the part to be removed is taken away from within, a hand introduced into the peritonæal sac and behind the bladder, keeping touch of the catheterised ureter and guiding the scissors. A stitch is then passed through the ureter so that it can be easily pulled up and cut across where desired. Sutures are then passed across the lower vesical wound, and some having been tied, a hole is made in the posterior wall of the bladder, the ureter is pulled through, split longitudinally for a short distance, and its mucous membrane sutured to that of the bladder. If possible, one or two sutures are put in from outside to strengthen the point of junction. When this is made complete a catheter is passed into the ureter and brought out through a tube through a supra-pubic wound. The bladder wound is closed round the tube, and the space between the bladder and the pubes is kept packed with iodoform gauze.

Complete Extirpation of the Bladder.†—This operation has been performed by Bardenheuer and Gussenbauer. The first successful case was by Paulick of Prague. Clado has had a second. Both of these were in women. In each case the operation was done in two stages, the ureters being first diverted to and secured in the vagina, and then, about three weeks later, the bladder removed. The vagina by the second operation was converted into a pseudo-bladder. Paulick's patient was alive two years and a half after the operation, and in fair comfort. Drs. Tuffier and Dujarier (*Revue de Chirurgie*, April

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* This step gives but little extra room, and opens up cancellous tissue and thus fresh sources of septic phlebitis.

† A paper by M. Chevalier (*Arch. Gén. de Méd.*, t. ii. 1894) contains much information on partial and complete resection of the bladder.

1898) describe a successful case of complete extirpation of the bladder in a man in one operation, the ends of ureters being transplanted into the rectum. Two months after the operation the man was able to do his work.

Causes of Death after Removal of Bladder Tumours.

1. Shock. Mr. R. Harrison (*Lancet*, 1884, vol. ii. p. 678) records a case of a man, aged 42, who died somewhat suddenly, apparently from shock, twelve hours after removal of a villous tumour by the perinæal method. The hæmorrhage, which had begun four years before, had for a year been persistent and considerable. Mr. Harrison, in illustration of the sudden and excessive bleeding to which villous tumours are liable, even when they appear comparatively quiescent, has published (*Liverpool Med.-Chir. Journ.*, July 1884) a case where death took place from this cause in nine hours. In this instance slight hæmaturia had existed for some months previously, but no operation had been performed. Mr. Morton has drawn attention (*Lancet*, 1896, vol. i. p. 480) to the possibility of secondary hæmorrhage. In his case a papilloma had been removed supra-pubically, the pedicle being cut through with scissors. Severe bleeding took place on the third day, necessitating opening up the wound. The patient recovered. 2. Exhaustion. 3. Cellulitis. 4. Failure of the kidneys. Evidence of this will of course be sought for before. It is most likely to occur in growths which from their position have obstructed the outflow of urine. 5. Injury to the bladder and peritonitis. Mr. Bryant (*Lancet*, 1886, vol. ii. p. 1077) mentioned a case in which a fibrous polypus was drawn from the fundus into the perinæal wound and snipped off. The man died of peritonitis, and a small hole was found in the bladder at the site of the removed polypus. 6. Recurrence. This may appear first in the cicatrix of the wound. 7. Abscess in the track of the apparently healed wound, bursting into the peritonæal sac (Sir H. Thompson, *Clin. Soc. Trans.*, vol. xxi. p. 46).

OPERATIVE INTERFERENCE IN TUBERCULAR DISEASE OF THE BLADDER.

My own experience in several of these cases and a study of what others have published leave me strongly of opinion that operative interference in the form of cystotomy is rarely justifiable here. My reason for this opinion will be gathered from the following **Indications and Cautions.** (i) It is an accepted fact by all careful surgeons that in tubercular affections in which it is not possible to remove the mischief, operative interference may do more harm than good. Under such conditions the manipulations only irritate early tubercle into activity, and light up again obsolete or quiescent tubercle, besides causing certain dangers* peculiar to this viscus—viz., cystitis and pyelitis. Again, to show how useless and even harmful will be operative interference in the early stage of tubercular mischief—a stage in which alone can such treatment be expected to be curative—let us consider what are the conditions present at this early stage. To put it briefly, it is not one suitable for curetting, &c., as is often the case with tubercular mischief elsewhere.* The mucous membrane is swollen, very vascular, velvety, at times gelatinous. Any ulcers present are often small, even minute and numerous, so that it is impossible to make sure of efficient curetting, especially when anyone familiar with the interior of the bladder knows how quickly a little bleeding hides the field of operation, and the fact that the mischief is usually most marked on the posterior wall, trigone, and neck. The following is a good description of a condition often present in these cases (J. Bell, M.D., of Montreal, "Treatment of Tuberculosis of the Bladder by a Supra-pubic Section." *Journ. Cutan. and Genit. Urin. Dis.*, 1892, p. 298): "The trigone and a band of about an inch in depth around the urethral orifice were the seat of many superficial ulcers, varying in size from that of a split pea to irregular patches as large as a five-cent piece. The mucous membrane of the whole fundus of the bladder was also studded with small tubercles which had not advanced to the stage of ulceration nor, indeed, even to the length of showing signs of caseation. The ulcerated patches were scraped and cauterised, but the little non-ulcerated tubercles were left untouched. They were so numerous that it would have been impossible to deal with each one singly." Mr. Battle's case (*Clin. Soc. Trans.*, vol. xxiii. p. 201), which was greatly benefited by scraping after other treatment had failed, owes its success largely to the condition found, which was, I think, a very rare one. The ulcerated surface was single, though very extensive, spreading over the left lateral and posterior wall, from the trigone almost to the summit, with the bladder relaxed. After the ulcer had been scraped, it was dabbed over with a solution of chloride of zinc (30 gr. to ℥j). The patient was seen nearly a year later, soundly healed and able to hold her water for three hours at a time. It is not stated whether pyrexia was then present. (ii) For these reasons I am strongly of opinion that in the earlier stages we should treat tubercular disease of the bladder not by operation† but by improving the hygienic surroundings, especially, whenever it is possible, getting the patient to be much in the open air, if possible by the sea, teaching him to wash out his bladder with iodoform emulsion and dilute mercury perchloride lotion, and in the case of a woman, giving an anæsthetic at intervals and swabbing over the mucous membrane with a solution of $AgNO_3$ ʒij—℥j, the urethra having been rapidly dilated. (iii) The cases that call for operative interference are those in which what I may be allowed to call hygienic treatment has failed, or in which the case has got beyond this, where pain is incessant, micturition frequent—*e.g.*, every half-hour day and night, with much tenesmus, and where opiates are required to afford sleep. There should be no advanced disease present of the other urino-genital organs, kidneys, lungs, &c. (iv) The supra-pubic operation is always to be preferred. The perinæal gives very little room, and moreover has the great drawback that a tube thus introduced will very likely press upon the neck, or trigone, parts very liable to be attacked by tubercle. Again, this opening has a great tendency to close before the full benefit of drainage has been secured. The vaginal opening seems to me to be liable to the same objection as the perinæal—viz., that the vesical end of a tube thus introduced is very likely to rest against an ulcerated surface. (v) The patient should be warned that supra-pubic drainage often involves prolonged confinement to bed, and that the discomforts which must attend the constant soakage of urine are only to be partially met by the use of large absorbent pads. (vi) The tube should, if possible, be withdrawn in about three weeks, and, as soon as the wound is closed, every effort should again be made to place the patient under the best hygienic surroundings, to the necessity of which I have alluded above. Hospital patients should be got into better air at once. But too often the after-treatment of supra-pubic cystotomy for tubercular cystitis resolves itself into the following dilemma. If the opening is closed all the pain, &c., soon recurs; if it is kept open there is much difficulty in preventing noisome soaking. A tube and plug worn in the supra-pubic sinus rarely acts well in these cases, where the bladder is often small, contracted and thick-walled. (vii) The patient may enjoy years of fairly active and happy life after a supra-pubic cystotomy, if the opening has closed within a reasonable time of the operation, but he will be liable to other outbreaks of tubercular mischief, secondary to disease which was probably present, though quiescent, at the time of the cystotomy—*e.g.*, tubercular testis and kidney.

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* Another ill result which is very possible here is rupture by even a moderately distending injection of a contracted, rigid bladder the seat of long-standing tubercular mischief, and one emptied for some time by irritability and incontinence. I would refer my readers to two such cases candidly published by Mr. H. Fenwick in his instructive book, *Cardinal Symptoms of Urinary Diseases*, p. 200.

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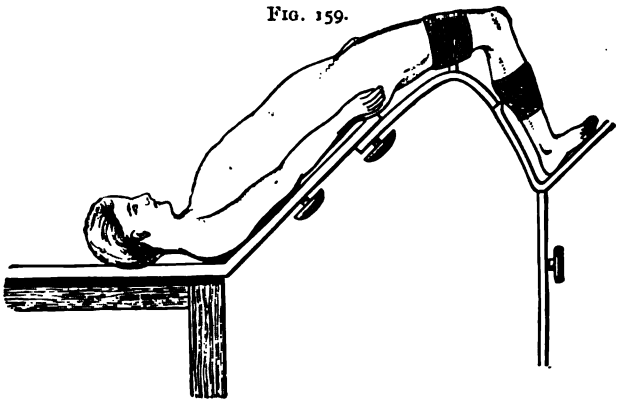
* Prof. Guyon reported (*Ann. des Malad. des Voies Urin.*, Nov. 1889), very fully, four cases which he treated by curetting and the cautery after a supra-pubic cystotomy. One of the four died, two years after the operation, the patient having a persistent sinus and being bedridden most of the time. One died within the year, and one within about three months of the operation. The fourth had survived four years.

† Dr. L. Bolton Bangs, of New York, whose experience in diseases of the genito-urinary organs is a very wide one, thus expresses himself on this matter: "After faithful and zealous efforts to relieve by surgical interference the local symptoms of these cases, I have been forced to the conclusion that the less instrumentation we resort to the better."

FIG. 159.



Trendelenberg's position. (R. Harrison.)

Operation.—The details of a supra-pubic cystotomy are so fully given at pp. 379, 400, that it is needless to repeat them here. I will only add the caution that great care must be taken in distending these bladders. Four to six ounces will be as much as can usually be injected with safety. The bladder is first opened and its interior exposed with some suitable speculum (p. 379), aided, if needful, by the Trendelenberg position (Fig. 159). Any ulcers should be carefully and thoroughly curetted or cauterised with a fine point of the Paquelin's thermo-cautery, iodoform rubbed over the surface or left in, in the shape of the emulsion. To any very vascular, gelatinous-looking mucous membrane, not ulcerated, a solution of $AgNO_3$ ʒij—℥j* should be applied on a small sponge on a holder.

The following is a good instance of the relief which supra-pubic cystotomy may give in a very obscure case :—

In May 1890 I was asked by Dr. Cock and Dr. Hodgson, of Exmouth, to explore the bladder of a gentleman, aged 57, suffering from painful cystitis, hæmaturia, and frequent micturition, to which general treatment, washing out the bladder and drainage by a catheter, had failed to give any relief. Calculus being excluded by sounding, and there being no rectal enlargement of the prostate, I expected to find a small malignant growth, as the symptoms were too urgent for prostate trouble, and as this gland was not enlarged either to the finger or the sound. The bladder, having been opened and emptied by the supra-pubic method, at first appeared normal save for some sub-acutely inflamed rugæ which stood out very distinctly on the right lateral aspect of the neck of the bladder. A small electric lamp at once showed amongst these folds two ulcers each about 1 inch by ¼-inch, oval in shape, with muscular fibre clearly exposed on their floors, their edges neither thickened nor indurated. They were scraped with a sharp spoon, and iodoform was then rubbed into their surfaces. The patient made an excellent recovery, and now, six years later, remains quite well. In this patient, with a deep, fat perinæum, I should never have detected the ulcers by the perinæal route.

PARTIAL PROSTATECTOMY.

We owe our knowledge of what this operation can do to the late Mr. McGill, of Leeds (*Brit. Med. Journ.*, Oct. 19, 1889).† The following propositions are taken from his paper :—i. Prostate enlargements which give rise to symptoms are intra-vesical, not rectal. Thus prostates of immense size which project towards the rectum cause no urinary trouble, while severe symptoms may supervene when the prostate on rectal examination is apparently of normal dimensions. ii. There are many varieties of the intra-vesical growth. We find (1) a projecting middle lobe—pedunculated or sessile, (2) a middle lobe with lateral lobes forming three distinct projections, (3) the lateral lobes alone, (4) a pedunculated growth springing from a lateral lobe, and (5) "a uniform circular projection surrounding the internal orifice of the urethra." This variety, described by Brodie, is not infrequent, it surrounds the urethra like a collar, and projects for a variable distance into the bladder. iii. In many cases self-catheterism is the only treatment required. iv. That when this fails, or is unavailable, more radical measures are necessary. v. That this treatment, to be effectual, should (1) for a time thoroughly drain the bladder; (2) permanently remove the cause of the obstruction. vi. That the supra-pubic route is preferable to the perinæal for prostatectomy. Most surgeons will agree with this; the question is alluded to at p. 378, and again below. This operation was short-lived, as it was laid aside for the much less severe one of double castration. This step has given such encouraging results (p. 479) that it will probably replace prostatectomy in many of those cases which call for some operative interference.

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* This may appear strong, but it gives very marked relief. In women it may be applied at repeated intervals after dilatation of the urethra. If it should give much pain, which, in my experience, it rarely does, a solution of sodium chloride may be injected.

† Much information will be found in the following papers :—Watson, *Ann. of Surg.*, 1889, pp. 1-27 ; Belfield, *Amer. Journ. Med. Sci.*, Nov. 1890 ; Moullin, *Brit. Med. Journ.*, 1892, vol. i. pp. 1185, 1250, 1294 ; White, *Ann. of Surg.*, 1893, p. 152 ; Woolsey, *Journ. Cut. and Gen. Urin. Dis.*, July and Aug. 1895.

Indications.—As double castration seems to give sufficient relief at a very much smaller risk, it appears to me that prostatectomy should be confined to the following cases:—(1) Where one or more calculi co-exist with an enlarged prostate. I have myself operated on two such cases.

In one, the patient, aged 58, was in a condition of extreme misery from cystitis, dysuria, and tenesmus, and the catheter had to be resorted to every ten minutes. By supra-pubic cystotomy I removed a calculus and prostatic tissue from the median and lateral lobes weighing three-quarters of an ounce. He made a good but slow recovery, the sinus being very tardy in closing. Two years after he was holding his water for three or four hours in the day, and was only disturbed once at night. The residual urine amounted to about half an ounce. In the other patient, a calculus and great vesical enlargement of the prostate co-existed in a man of 59, whose kidneys we knew to be damaged. After removal of the calculus and an ounce and three-quarters of enlarged prostate the patient did well for two days. An injection of morphia had produced such grave symptoms that I forbade any more being given. The patient's restlessness being troublesome, the house-surgeon, thinking that he knew best, disobeyed my directions and repeated the morphia. Contracted pupils and stupor quickly followed and the patient sank. At the necropsy the kidneys were granular; the remains of the prostate showed the usual ragged surface, but, under the circumstances, not an unhealthy one.

(2) Where the operation of double castration fails, as it does in some cases. (3) When a patient refuses double castration but is willing to submit to the greater risk which has been fully explained to him. The cases I consider to justify operative interference are given under the heading "Castration" (p. 479). The patient will, of course, be got into as satisfactory condition as possible before operation by attention to aperients, baths, diet, drugs, such as urotropine and sandal-wood, and washing out the bladder.

Choice of Operation.—The surgeon has to make a choice between a number of different methods, all of which have their advocates. The following are the most important of these:—

1. McGill's supra-pubic method *without* perinæal drainage.
2. Fuller's supra-pubic method combined with perinæal drainage.
3. Von Dittel's operation, which consists of removal of the prostate by means of an extensive dissection of the perinæum.
4. Nichol's operation by which the prostate is dissected out through the perinæum, pressure being made from above through a supra-pubic cystotomy wound.
5. Alexander's operation, which is Nichol's operation, with the addition that the bladder is drained through a perinæal opening.

It will be seen that the choice lies between reaching the prostate through a supra-pubic opening into the bladder or by means of a deep dissection of the perinæum. The supra-pubic operation has the great advantage that by it the enlarged prostate can be best seen, felt, examined and operated upon. It is much more generally applicable, as by it both the middle and lateral lobes can be entirely removed if necessary, as shown by Freyer (*Brit. Med. Journ.*, vol. ii. 1901, p. 125), who describes four successful cases of removal of the entire prostate by the supra-pubic route. It admits of our doing this, aided by an electric lamp if needful, with much more precision and completeness. On the other hand, the perinæal route gives much the best drainage and is best suited for the removal of sub-urethral growths, and for some cases of enlargement of the lateral lobes, *e.g.*, where this is not only intra- but extra-vesical, and so closing the prostatic urethra. These cases are, however, rare; as a rule we have to deal with hypertrophy of the median lobe and of the intra-vesical aspects of the lateral lobes, and all the work that is required can be done from the interior of the bladder. The perinæal route has the serious drawbacks of giving very little room; by it operating is done in the dark; in patients with a deep, fat perinæum the "perinæal distance" may make it quite impossible for the operator to satisfactorily remove the obstruction. Moreover, the perinæal dissection must needs be extensive and difficult, and presumably altogether a more severe operation than a supra-pubic wound.

The mortality of the operation is high, varying between 15 and 20 per cent. in the different collections of cases, but is somewhat higher after the perinæal methods than the supra-pubic ones.

For these reasons the supra-pubic operation is certainly to be preferred to the perinæal, which should only be undertaken in those rare cases in which it is found impossible to remove the obstruction through the supra-pubic wound alone.

As a rule, then, the surgeon should begin with the supra-pubic method, adopting the perinæal afterwards, if he finds it necessary, in order to secure a low-level route for the removal of extra-vesical lateral or sub-urethral enlargements, or to secure efficient drainage.

Operation.—The full accounts of supra-pubic cystotomy given at pp. 379 and 399 should be referred to; only those points which relate to the special technique of prostatectomy will now be given. The quantity of water (p. 401) injected into the rectal bag, if one is used, especially when the prostate is abnormally hard, should not exceed six to eight ounces. Where the bladder is contracted with thick non-distensible walls, it will usually be inadvisable to perform this operation. A catheter left in the bladder, till this is opened, expedites the operation. Mr. McGill advised that the bladder be stitched to the cut edges of the wound before any attempt be made to remove the prostate. If this is done it will interfere with the subsequent suture of the bladder which I recommend below. I think the same end can be secured by holding the bladder well up with a pair of Spencer Wells's forceps on either side, each taking hold at a point opposite to the part to be left open when the sutures are inserted (*vide infra*). Enucleation is to be performed as much as possible by the finger. This not only prevents hæmorrhage, but the finger will turn out, far more intelligently, safely, and quickly, much larger pieces than any vulsellum or punching-forceps. First, however, a way must be made for the finger. This is effected by taking away any projecting portions with such forceps as Jessop's, or by dividing the overlying mucous membrane with scissors as described by Dr. E. Fuller, of New York (*Journ. Cut. and Gen. Urin. Dis.*, June 1895, p. 232). The bladder having been opened, the extent of the prostatic enlargement and the site of the urethral opening are determined: "A pair of rough, serrated-edged scissors with a long handle grasped in the right hand are slipped along the left forefinger into the urethral opening, and are made to cut through the bladder wall in that region. The cut extends from the lower margin of the internal vesical opening of the urethra backward for an inch or an inch and a half. The blades of the scissors being rough and serrated, make an incision which bleeds but little. Then one of the forefingers, whichever the operator may find the more convenient, is slipped through the vesical hole made by the serrated scissors, while at the same time the fist of the other hand makes firm counter-pressure against the perinæum. By means of this counter-pressure the prostatic growth is brought well within reach of the forefinger of the other hand, which is employed all the time in enucleating the obstruction *en masse*, or piece by piece, as the case may be. This enucleation should not be desisted in until all the lateral and median hypertrophies, as well as all hypertrophies along the line of the prostatic urethra, have been removed." Dr. Fuller states that owing to the small amount of bleeding he has always found it feasible to sew up the supra-pubic incision as described below, and that he has never had trouble with secondary hæmorrhage. A perinæal section is next made and a large-sized rubber tube passed through the perinæal incision, and that through which the prostate was enucleated, into the bladder. After this hot-water irrigation is employed for some time to stop oozing. Next, the supra-pubic wound is closed by a deep layer of catgut sutures which include the bladder wall, and by a more superficial layer of silk-worm gut. The middle of the incision is not closed, but a deep provisional salmon-gut suture is inserted here, taking up the walls of the bladder and the abdomen. A drainage-tube is inserted, and when this is removed in four or five days the provisional suture is tightened up. Six cases of prostatectomy, five of these operated on by this supra-pubic method, are given by Dr. Fuller; all were successful.

After the surgeon has removed all that he considers necessary from within the bladder he must carefully examine the urethra both with his finger and by full-sized catheters passed from the meatus. Belfield attaches great importance to this. In one of his cases, after removing from the left lateral lobe as much as a walnut, he found that there was still an obstruction in the prostatic urethra to the passage of a catheter. By perinæal section a rounded mass was shelled out.

Hæmorrhage must be arrested by the means given at p. 382.

The amount removed must vary with each case. Prostatic tissue is not heavy, and any amount over an ounce and half will be rarely removed. Mr. Buckston Browne (*Clin. Soc. Trans.*, vol. xxii. p. 274) removed in one case gland tissue amounting to nearly four ounces. A good recovery followed.

LATERAL LITHOTOMY (Figs. 160, 161, 162).

Owing to the introduction and perfection of the crushing operation for stone, lateral lithotomy is now seldom called for. The chief indications are:—(1) In children, when the stone is a small one, and when the surgeon is inexperienced in the use of the lithotrite, it is the operation of choice. (*Vide* also the remarks on pp. 421–423.) (2) In the case of a large stone with which it has been decided to deal by perinæal lithotrity (p. 421) the bladder is opened by the same steps as in lateral lithotomy. (3) In certain cases of stricture of the urethra and enlarged prostate, where a staff can be passed. In the majority of the cases of enlarged prostate, however, the supra-pubic method is to be preferred, as by this means the prostatic hypertrophy can be more readily dealt with at the same time (p. 399).

The lateral operation will be described under the following heads :

A. **Preparatory Treatment.**
B. **Passing the Staff. Possible Difficulties.**
C. **Finding the Stone. Possible Difficulties.**
D. **Entering the Bladder. Possible Difficulties.**
E. **Extracting the Stone. Possible Difficulties.**

A. **Preparatory Treatment.**—For a week or so before the operation the diet should be bland, so as to tax as little as possible jaded kidneys—*e.g.*, milk, barley-water, light puddings, and a little fish. If alcohol is needed, some sound spirit, well diluted, should be given. Baths should be taken regularly, the bowels well moved, and an enema given on the morning of the operation, and care should be taken that all this has come away.

B. **Passing the Staff.**—This step, however simple and easy usually, presents occasional difficulties, the more trying, because perhaps unlooked for; they are—

(1) Spasm, from the urethra not being used to instruments. (2) Stricture. (3) A false passage. (4) An enlarged prostate. (5) An enlarged prostatic sinus, into which the end of the sound passes. Mr. Buckston Browne's staff meets the last two admirably.

C. **Finding the Stone with Sound or Staff. Possible Difficulties.**

(1) The stone may have been passed.* This is not impossible in children with small, smooth, narrow calculi, and their sudden, strenuous micturition. (2) The stone may lie behind an enlarged prostate. Here the finger of an assistant passed into the rectum may help. (3) The stone may be enveloped in folds of mucous membrane. Injection of the bladder is here indicated. (4) The stone may be encysted. This is so rare as to have been called "the refuge of young lithotomists." The following case of Sir G. Humphry (*Some Cases of Operation*, pamphlet, 1856) shows well how embarrassing this condition may be :

A man, aged 51, was cut, then submitted twice to lithotrity, then again cut in the old scar three times, all within six years, for an encysted calculus. On the fourth occasion of lateral lithotomy the nature of the case was made out accurately. The stone was now felt behind the prostate attached to the bladder by a pedicle which seemed to penetrate the coats of the viscus, and to be attached to another mass beyond it. It was evidently a stone of hour-glass shape, part being in the bladder and part in the sac. At each of the previous operations the part within the bladder had broken off, the rest not being extracted, owing to the size of the prostate. The symptoms recurring, urethro-rectal lithotomy was performed. The stone being now within reach, the edge of the mucous membrane around it was incised with a hernia and a stone, the size of a walnut, and with a truncated stalk, extracted. Death lace in two days, from pelvic cellulitis. Though the bladder was otherwise but liseased, the cyst seemed to have originated from the protrusion of mucous ane between the muscular fibres, as another one existed, though without a The cyst communicated by a considerable opening with the foul, infiltrated . Sir George points out that these cysts may be quite out of reach in lateral

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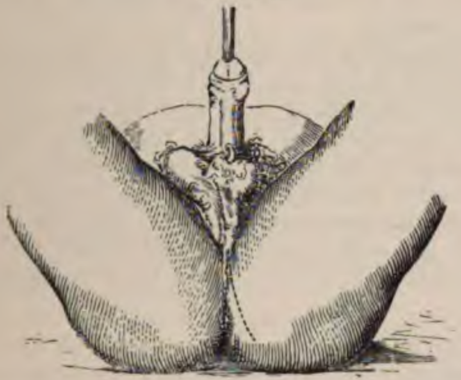
* *Cf.* the case mentioned by Mr. Holmes. *Clin. Soc. Trans.*, vol. ii. p. 67.

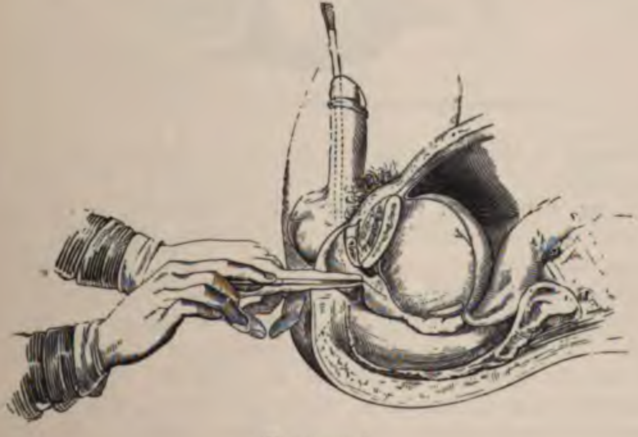
FIG. 160.



(Fergusson.)

my. As their walls consist only of cellular tissue, mucous membrane, and s a thin layer of muscular fibre, they are easily lacerated during an operation, ident almost certain to be fatal. The diagnosis is usually to be made if the s always struck by the sound at one spot, especially if, per rectum, a lump is

FIG. 161.



(Fergusson.)

d corresponding to that spot.* The supra-pubic operation is indicated here, tnote, p. 399.

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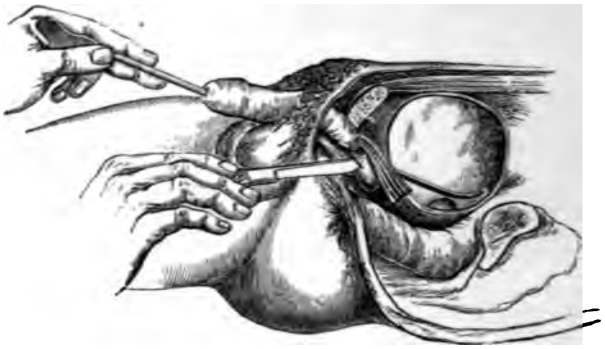
* J. E. Erichsen (*Surgery*, vol. ii. p. 945) adds that the beak cannot be made to und such a stone, so as to isolate it. To several other allied conditions of cated stone, see the reference at p. 411.

D. **Entering the Bladder.**—The time chosen for introducing the staff varies with different operators. Passing the staff while the patient is still recumbent is the easier; passing it when the patient is in lithotomy position is rather more difficult, but secures the operator against the risk of the staff slipping out after the patient is brought down into position, a risk which is greater with the straight staff. I prefer to bring the patient's lower limbs over the edge of the table, to pass the straight staff while he is recumbent, and then to have his limbs only brought up into position.

The nates just projecting over the edge of the table, the sacrum being flat upon it, the flexed thighs and legs being held well out of the way, the surgeon, seated comfortably, and with his face on a level with the perinæum, directs an assistant so to hold the staff as to bring the membranous urethra close to the surface of the perinæum. If a curved staff be used, this is easily done by inclining the handle strongly towards the abdomen. By this manœuvre, in Mr. Cadge's words (*loc. supra cit.*), the point of the staff "need not, and should not, be withdrawn from the bladder, but if it were it would be of no moment, because it would re-enter it the moment the handle is raised; the membranous urethra, instead of being almost perpendicular to the surface of the perinæum, as it is when the staff is held upright, is brought almost parallel with it, and is much easier to find with the knife; there is no inducement to open the urethra too far forwards, and consequently no risk of wounding the bulb or its artery. The staff gets a steady rest against the front of the pubes, and there is no danger to the rectum at this stage." It thus combines the advantages of the two very different methods usually given—viz., either to hold the staff well up firmly under the pubes and thus away from the bowel, but also away from the stone; or closely down upon the latter and in proximity to the rectum also.

FIG. 162.



Lateral lithotomy with a straight staff. (Key.)

Having felt the staff thus presented towards him, having examined into the depth of the ischio-rectal fossa, the site of the tuber and ramus ischii, the surgeon pressing up the junction of the scrotum and raphé so as to make tense the parts just about to be cut, enters his knife from a quarter of an inch to one inch and a half from the anus, just to the left of the raphé, and very likely hits the groove at once. The knife is then drawn outwards and backwards with a rapid sawing movement, to a point midway between the anus and tuber ischii, thus making an incision of two or three inches, according to the age of the patient and size of the stone. Again inserting the knife into the upper angle of the wound, the surgeon makes out exactly with his left index finger the groove in the staff, and exposes this, beyond doubt, in the wound. The next steps differ somewhat, accordingly as the curved or straight staff is used—they will be given separately.

(*a*) **With the Curved Staft.**—When the knife's point is felt firmly lodged in the groove, its handle is a little depressed, the blade, at the same time, turned a little to the left, is pushed steadily along the groove till a gush of urine or a sense of resistance ceasing, or both together usually, announce that the neck of the bladder has been sufficiently divided with the knife. The finger is now wormed into the bladder over the concavity of the staff.

(*b*) **With the Straight Staff.**—When the point of the knife is felt to be safely lodged in the groove, the surgeon takes the handle of the straight staff from his assistant, brings it down, and still keeping his knife in the groove, lateralises the staff slightly to the left, the handle of the knife being now depressed so as to form a sufficient angle with it, and make an adequate wound, the surgeon runs it along the groove steadily, till he knows by the above given evidence that the neck of the bladder has been sufficiently cut.

The left index finger is next wormed over the edge of the staff, the straight staff being held by the surgeon himself, in his right hand, the curved one being held by an assistant, till he feels that he has entered the bladder and placed the finger tip, if possible, in contact with the stone. Entrance into the bladder is known by feeling the finger surrounded with a smooth cavity, lined with mucous membrane, while the finger itself is girt by a fibrous ring. The stone being felt, or the bladder cavity distinctly gained, the staff is withdrawn, and the surgeon, while taking his lithotomy forceps, dilates the opening into the bladder with his finger, which, at the same time, pulls down and steadies the neck.

Failure to Enter the Bladder.—This most vexatious and embarrassing difficulty is most likely to be met with under two widely different conditions—(1) most frequently, in little children; (2) in old patients with a very fat, deep perinæum, and enlarged prostate. The first must be considered separately.

(1) *In Little Children.*—The causes here are, the small size, delicacy, and mobility of the neck of the bladder and urethra, and the fact that the bladder lies high up above the pelvis. Mr. Cadge quotes the following from Sir W. Fergusson:

> "The point of the finger was, as usual, placed on the staff and pushed gently towards the bladder. The finger went on, but I was aware that it had not got between the urethra and the staff. With an insinuating movement (much to be appreciated by the lithotomist, who, as I do, professedly makes a small incision in this locality), I endeavoured to get its point, as usual, into the urethra and neck of the bladder. But here I felt convinced that I had failed, and was aware that the finger was getting deeper as regards the depth of the perinæum, but that I was not materially nearer the bladder. I could feel a considerable space at the point of the finger, and was convinced that the upper part of the membranous urethra, as well as the sides, had given way to the pressure, and that now, as the finger was getting deeper into the wound,

> I was only pushing the prostate and neck of the bladder inwards and upwards. These parts seemed to recede before the smallest imaginable force, whilst I felt that I could, in a manner, make any amount of space around the bare part of the staff. I had no difficulty in distinguishing between the surface of this space and that of the mucous membrane of the bladder. Moreover, I knew that I had never crossed that narrow neck which is always felt as the finger passes into the bladder when a limited incision is made. An impression came over me that I was about to fail in getting into the bladder, and I had an idea that, unless I could open the urethra in front of the prostate more freely, I should probably never reach the stone. This I effected with great caution, and then I could appreciate the passage of the finger as usual through the neck of the bladder. The stone was easily touched and removed, but I was forcibly impressed with the idea that I had nearly failed in the performance of the operation." The child here was 4 years old.

Mr. Cadge thus met the same difficulty in an infant of one year and a half:

> "I felt the impossibility, even with a fair incision, of distending the wound with my finger: it was like trying to get into the orifice of the urethra. I therefore desisted before doing any harm, and, taking a pair of common dressing-forceps, I passed them easily along the staff into the bladder: by opening the blades gently but firmly, room was gained, and the finger entered and made room for small lithotomy-forceps. But I have repeatedly, after passing the dressing-forceps, withdrawn the staff and removed the stone with them, and without introducing the finger at all."

Difficulties and Mistakes during this Stage of entering the Bladder.—This is so important a part of the operation that the following may be enumerated here:

1. Finding the staff. This is not likely to present difficulties in the case of a curved staff if it be held as advised at p. 393. Hitting a straight staff in a fat child is not always easy, owing to the small size which is needful. Attention must be paid to entering the knife at the root of the scrotum only just to the left of the raphé, when the finger-nail will detect the staff at once. 2. Not exposing the staff. Everything which lies over the staff in the upper angle of the wound must be clean cut. The tissues here, including the membranous urethra, are lax and delicate, and, unless the knife is clearly in contact with metal, the groove will not be followed. 3. Losing the groove. This most serious accident may be due to not getting the knife cleanly into the groove, not keeping it sufficiently firmly in contact with it, and, thirdly, by forgetting to depress slightly the handle of the knife. 4. Cutting the prostate too freely as the knife is brought out. This can easily be avoided by keeping the knife sufficiently near to the staff. 5. Cutting into the rectum. This may be due to neglect of the following precautions: (1) Keeping the staff up away from the bowel; (2) guarding the bowel with the left forefinger in the wound; (3) when the knife is lateralised, cutting away from the gut. Mr. Cadge (*loc. supra cit.*) points out that the usual place of puncture is the dilated part just above the internal sphincter, and that this communication may be made secondarily by sloughing after extraction of a large stone, or after the use of a plug for arresting hæmorrhage. His experience is that "Nature seldom fails to bring about a cure, or so to contract the wound as to leave but trifling inconvenience." 6. Wounding the posterior wall of bladder.

Sir S. Wells, at the discussion of Sir H. Thompson's paper (Med-

Chir. Soc., April 2, 1878), mentioned a case in which Mr. Tyrrell wounded the back of the bladder, and hence always advocated a short knife. That this accident happened even in the hands of Aston Key himself, I know through the father of an old Guy's man who was present at the time.

E. Finding and Extracting the Stone.—The surgeon's left index finger, having passed into the bladder along the concavity of the staff,* finds the stone, hooks this down as near to the neck as possible, and at the same time steadies the neck while it dilates the incision in it and in the prostate. This combination of movements requires most careful attention to each of its details separately. The most important of these is the dilatation of the neck and prostate. If the stone is found to be a large one, the deep part of the wound must be sufficiently free. It is well known how much has been written on this matter. The surgeon should begin by dilating the neck of the bladder carefully and equally in every direction, using a considerable amount of force in an adult, but not throwing this on any limited portion of the wound. It may be accepted as a certain fact that the wound in the prostate may extend through the whole of this body, without risk of cellulitis, if only the recto-vesical capsule is not torn through. As long as the finger is girt by a fibrous ring this mischief has not been done. Whether an extensive wound in the prostate had better be made by dilatation and laceration or by free incision will probably never be settled. The wise surgeon will avail himself of a safe use of both—that is to say, after dilating with forcible but equal pressure all around the original wound in the neck, he will introduce a blunt-pointed narrow-bladed bistoury flat against the pulp of his finger, and nick the remaining constriction at one or two places, then dilating again.

Next to the size of the stone the age of the patient must, here, be considered. After middle life, the cellular tissue around the neck of the bladder is not only loose, but abounds in enlarged veins. Hence the risk of causing not only cellulitis, but septic phlebitis, by dilating an inadequate opening by the tearing, bruising exit of the stone, instead of by the finger and knife combined.

The deep opening having been thus made sufficiently free, the surgeon, having selected his forceps, introduces them along the finger (thus further dilating the wound), the latter being withdrawn as the forceps enter. These held at first in one hand (the thumb in the ring) are fully introduced closed, then opened widely transversely, and, by a quarter-turn of the handles, the lower blade is made to scoop or sweep along the floor of the bladder, which will almost surely catch the stone. If this step fail, it is repeated, and if the stone is still not caught, the surgeon feels again for the stone either with the closed forceps or by again inserting his finger, which will bring down the stone, push off projecting folds of mucous membrane, &c. Differently curved forceps, supra-pubic pressure, and a finger in the rectum, may all help now.

The stone being caught, the finger again feels if it is held in its shorter axis; if so, it may at once be extracted, if moderate in size, by steady deliberate traction downwards and outwards. As long as the stone advances all is well; if not, gentle rotation may again start it on its way. In less easy cases Mr. Cadge's words should be remembered: "Should there be much resistance and no sense of gradual yielding, the surgeon will ask himself whether this is due to an insufficient opening, or to the projection of the ends of an oval stone laterally beyond the bladder. This latter may be known by observing that the bladder is brought bodily down, so that the prostate, which is probably large, is visible near the external wound; in this case the stone must be liberated, the finger again introduced, and a fresh hold taken. If the obstruction is due to a large stone and too small a wound, the latter is to be enlarged in the direction of the first incision; this, in the opinion of the writer, is preferable to making the division of the neck of the bladder on the opposite side, and preferable, too, to using undue traction and force."

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* This is only withdrawn when the stone is felt, not before.

In some cases a scoop will facilitate extraction, the stone being firmly held between the pulp of the left index finger and the concavity of the scoop. In children one finger in the rectum and one in the bladder will often serve the purpose.

The stone being out, the bladder is carefully explored with the finger, or a short-beaked staff, aided by pressure above the pubes, or from within the bowel, for any other calculi or fragments. Multiple calculi will have been indicated by facets upon the first.

Any bleeding vessels are now secured, a tube introduced, dressings applied, and the patient removed to bed.

Difficulties during the Stage of Extraction of the Stone.

(1) The position of the stone. This may be out of reach owing to its being at the posterior part of a dilated bladder, above the pubes, or to the patient having a very fat and deep perinæum. Pressure above the pubes, and the use of long forceps, are here indicated. (2) An enlarged prostate. This interferes with reaching the stone both with fingers and forceps. Curved forceps passed in along the staff, or a gorget, if the perinæum be very deep, will be helpful here, and perhaps a bag in the rectum would aid in raising up the stone within reach in difficult cases. An enlarged middle lobe of the prostate, or a separate adenoma of this gland, may also cause trouble by getting between the blades of the forceps. Tearing away of these portions of the gland has often occurred, and is sometimes certainly beneficial. It is doubtful, however, if this is always so. Thus Mr. Cadge (*loc. supra cit.*) thinks "that it is probable that a careful examination of the subsequent condition of such patients would show that, although it may not have endangered life, it has not infrequently been followed by partial inability to retain urine." Prof. Gross (*Trans. Philad. Path. Soc.*, vol. iv. p. 153) thought that in one case the cavity left behind became a suppurating pouch, and increased the difficulty in micturition. (3) Breaking up of the stone. This may occur with hard calculi from too much force being used with the forceps, but it much more often happens with soft phosphatic calculi. In such cases every fragment must be cleared out—a matter of some difficulty, as small ones are readily concealed in clots or folds of mucous membrane. After all the larger ones are picked out, a catheter of appropriate size, attached to a Higgenson's syringe, is inserted, and the bladder thoroughly and forcibly washed out with diluted Thompson's fluid (1 in 6 or 8, p. 402); or mercury perchloride 1 in 4000. In a week or ten days the bladder should again be carefully sounded, and

examined with the finger, and any fragment extracted, this being especially needful if pain has persisted after the operation.* If fragments still persist a little later, an evacuating-tube and washing-bottle, aided if necessary by a flat-bladed lithotrite, must be employed. I may here express my belief that multiple calculi are not quite as rare as has been supposed. (4) Size and shape of the stone. Mr. Erichsen writes n this subject: "A calculus, about an inch and a half in its shorter iameter, will be hard to extract through an incision of the ordinary ength (not exceeding eight lines) in the prostate, even though this e considerably dilated by the pressure of the fingers; and I think may be safely said that a calculus two inches and upwards in iameter can scarcely be removed by the ordinary lateral operation ith any degree of force that it is safe to employ." Most will agree ith Mr. Cadge that stones weighing upwards of 3 oz. will be dealt with y the improved supra-pubic method.

SUPRA-PUBIC LITHOTOMY (Figs. 163–166).

Indications.—The surgeon who has the opportunity of becoming an adept in the use of the lithotrite, both through the meatus and through a perinæal wound (p. 421), will seldom have occasion to perform supra-pubic lithotomy. Where, however, there has been no such opportunity, this operation will be required for the following conditions. These I quote from the concluding portion of a paper which I read before the Royal Medico-Chirurgical Society (*Trans.*, vol. lxix. p. 377).

1. "That supra-pubic lithotomy, as recently modified, has a future f renewed usefulness before it, and that while, as an operation, it can ever contrast with the rapid brilliancy of the lateral operation, it will e found of great value by those who only have to deal with stone ccasionally, and by those who find themselves face to face with calculi f considerable size in adults. 2. That, to give other and more indiviual instances, the operation will be found useful in (*a*) many cases of ard stones of an inch and a half in diameter; (*b*) in multiple hard ones; (*c*) in cases of calculus not phosphatic, occurring with enlarged rostate; (*d*) in some cases of foreign body in the bladder with abunant calculous deposit (Sir H. Thompson); (*e*) in cases of encysted one.† In the rarer cases of (*f*) a state of urethra which will not admit e use of a lithotrite or a grooved staff. . . . ." To these should be lded, (*g*) in cases where the stone is associated with enlarged prostate . 411). The supra-pubic opening will here be convenient for removing ortions of prostatic tissue as well as the stone.

The greater trouble and the longer time which this operation entails, oth during its performance and afterwards, will not be grudged in these days, when it is so much the rule to pay attention to the details of surgery. Only time and a larger collection of cases will show how far, with much simpler structures to cut, with these brought safely into reach, and with modern antiseptic details at hand in the after-treatment, this lithotomy is safer than the far more brilliant lateral one.

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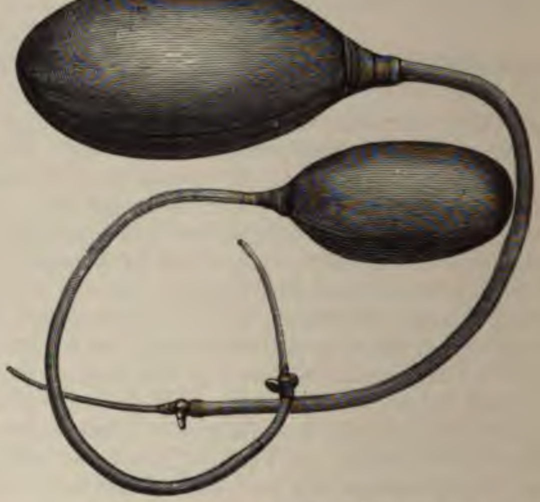
* Recurrence of stone within two years almost always means that a fragment has een left after the operation. No greater disappointment than this, both to the urgeon and patient, can happen. No one, probably, has cut fifty patients without aving to admit and lament its occurrence, but it is especially liable to occur to the inexperienced (Cadge).

† Much useful information may be gathered from a paper by Mr. Bruce Clarke (*Brit. Med. Journ.*, May 13, 1899), in which an account is given of twenty-seven cases f encysted vesical calculus.

Details of the Operation.*

A. **Distension of the Rectum.**—The utility of this is doubtful, except in certain special cases in which it is desirable to raise the base of the bladder and bring it as much within reach as possible, *e.g.*, in operations for tuberculous disease, and for the removal of tumours from the base of the bladder. For the effect of rectal distension is chiefly to raise the bladder bodily in a direction upwards and forwards, and hence after incision to make the base more prominent and easier to reach; the effect as regards the supra-vesical fold of peritonæum is, on the other hand, so small that it may be neglected. Moreover, the procedure is not without danger. If it is decided to make use of rectal distension the bag should be distended as required after the parietal incision has been made, so that the effect may be gauged by a finger in the pre-vesical space. The bag used for this must be (1) of sufficient strength, and (2) of appropriate size. Thus, it should be of as soft rubber as is consistent with strength, with seams as little prominent as possible,† and flattened rather than pyriform in shape.

FIG. 163.



Oval rectal bags, partly distended. A child's size is shown below.

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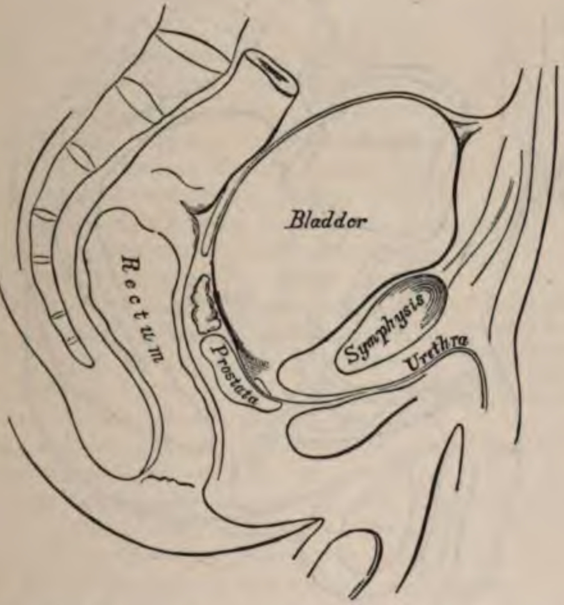
* These are largely taken from a paper of mine (*Brit. Med. Journ.*, Oct. 23 and 30, 1886).

† In two of my earlier cases a little blood-stained mucus followed the withdrawal of the empty bag; no ill results ensued, and as this has not occurred in the later cases I think it may be attributed to the use of the earlier bags of pyriform shape, stout rubber, and prominent seams. When a bag has not been obtainable the fingers of an assistant may be used instead.

) The amount of fluid. A flat, oval bag (Fig. 163), well coated with icalyptus and vaseline, entirely emptied of air and folded up, is troduced well above the sphincters (the bowels having, of course, en well emptied). It is then carefully distended by means of an sily working syringe with water varying in amount from 2½ to 3 oz. a child of five, to 10 or 12 oz. in an adult. Sir H. Thompson gives e amount in the adult as 12 to 14 oz. I would advise operators to be ntent with the smaller amount of 8 or 10 oz., adding a little more er on, if needful, and only to use the larger amounts in special cases *e.g.*, large stones, doubtful cases, or where a growth is present and it desired to give extra elevation and steadying to the bladder.

FIG. 164.



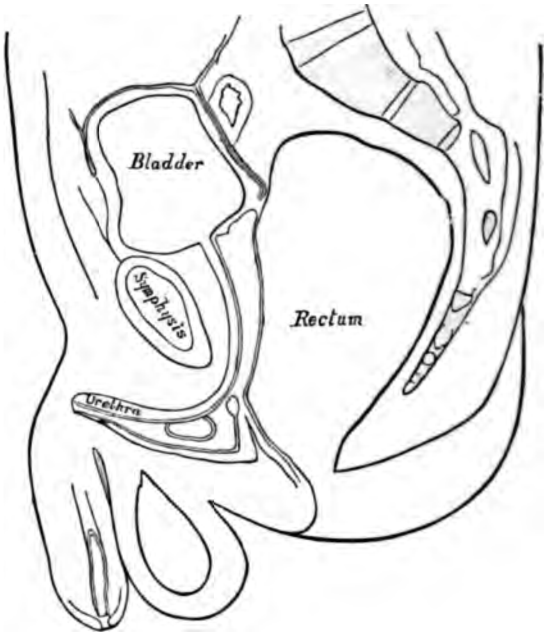
Sagittal median frozen section through the pelvis of a young man, the bladder being distended. (C. Langer.)

B. **Distension of the Bladder.**—Either water or air may be used this purpose, the chief advantages claimed for the latter being that its buoyancy tends to raise the bladder up to the surface, ereas the weight of water tends to drag it downwards towards the lvis; (2) being compressible, it is less liable to do damage when the adder walls are contracted and rigid; (3) there is no flooding of the und when the bladder is incised, and therefore less liability of fection of the peri-vesical cellular tissue.

The air may be conveniently introduced by means of a bicycle pump tached to the catheter by means of a length of rubber tubing, no easurement of the quantity used being necessary when the plan lvised below is adopted.

If distension with water is preferred to air, either Thompson's (borax, 1 pt.; glycerine, 2 pts.; water, 2 pts.) diluted one in six, carbolic acid one in eighty, or perchloride of mercury one in 4000 may be used. This should be introduced by means of an irrigator raised about a foot above the level of the patient's abdomen, in this way a safety-valve is provided against any sudden rise of pressure within the bladder if any straining takes place. If the plan advised below is adopted it is not necessary to measure the quantity of liquid, but if it is preferred to introduce this first it must be measured, in this case 8 to 10 oz. for an adult, and a smaller amount for a child will be found to suffice; larger quantities should not be used for fear of causing damage from over-distension. The safest plan is to carry out the distension of the bladder after the incision has been carried down to the transversalis fascia and the wound well retracted, as advised by Tilden Brown (*Ann. of Surg.*, vol. xxv. p. 141). The air or antiseptic solution can then be gently and slowly introduced, and its effect gauged by the eye and the finger placed on the bladder. In this way the supra-vesical fold of the peritonæum may be raised to the desired extent without the slightest risk of causing damage from over-distension.

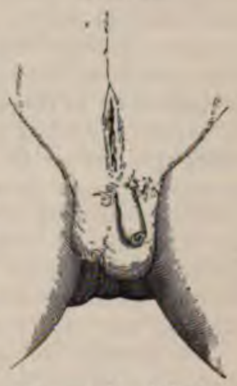
FIG. 165.



Sagittal median frozen section of male pelvis, with distension of bladder and rectum. (Garson.)

C. **The Operation Itself.**—The pubes having been shaved, the knees slightly flexed, and the shoulders a little raised, an incision is made about three inches long, exactly in the middle line and ending over the upper border of the pubes. The subcutaneous fat, often plentiful in amount, having been divided, and any vessels secured with Spencer rceps, the linea alba is identified,* nicked, and slit up for two ches. The transversalis fascia is then picked up at the lower he wound and divided. The retractors now drawing the edges nd well apart, a layer of loose tissue and of fat, often abundant, ently having large veins in it, will next come into view, lying concealing the bladder. This must be torn through carefully eanly as possible with the point of the director. Any veins ss the wound (and a transverse branch lies often just opposite f puncture into the bladder) should be ith forceps. If one is opened at this field of the operation will be obscured troublesome hæmorrhage.† This must ed by pressure-forceps, which act also ors, by sponge-pressure, or a very hot lotion—*e.g.*, hydr. perchl. 1 in 4000; manipulation in arresting hæmorrhage be the cause of that cellulitis later on so much to be deprecated. The anterior the bladder will now be recognised by colour, the fibres of the detrusor urinæ, ts fluctuating under the finger. Veins met with again here on the bladder gitudinal, transverse, and occasionally . Great care must be taken not to the fatty connective tissue which lies the anterior surface of the bladder and s. A spot on the anterior surface of ler having been chosen about three- of an inch‡ above the pubes, it is l (a hook being used if thought desirable), and the left index once introduced to feel for the stone. The finger at the keeps the bladder hooked up, and prevents it settling back elvis as the bladder collapses. The stone is best removed by rs, or, if preferred, by forceps or scoop. The fingers, if suc- ave the advantage of not risking any injury to the mucous . Removal of the stone is not always easy; it falls back into

FIG. 166.



Supra-pubic lithotomy incision, seven days after the operation. Only the upper part of the wound was sutured.

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ead of exactly hitting off the linea alba at once, the surgeon exposes fibres or pyramidalis, he should go straight on through these with a director. ged search for the linea alba will leave frayed fibrous tissue, which will usly, and become coated with phosphatic deposit if the urine be ammoni- e muscles are thus torn through, it must be remembered that they lie on ransversalis; there is no sheath behind them.

on in his second case met with most profuse hæmorrhage: "Nous essay- ssez vainement, à nous opposer à l'envahissement de toute la plaie par une ng sans cesse renouvelée." After repeated and fruitless attempts to arrest rhage, the bladder was opened and the stone removed. The hæmorrhage rely on the removal of the rectal bag. The patient, aged 69, died with filtration of the sub-peritonæal connective tissue. Such severe hæmorrhage e.

t chosen must not be too low, or infiltration may take place into the cavum nd the pubes; if too high, drainage will be interfered with and the peri- dangered.

the fundus, or into sulci on either side of the part raised by the bag, if one has been used. As soon as the calculus is removed and the bladder is thoroughly explored, the fluid should be set running from the rectal bag, as emptying this takes some time.

Great difficulty may be met with in removing an encysted calculus, owing to the fact that the stone usually entirely fills the sac, the neck of which is frequently quite narrow. If the neck cannot be sufficiently dilated to deliver the stone, whole, through this, the plan recommended by Hurry Fenwick (*Medical Annual*, 1901) may be made use of. It is described as follows:—"If there is a projecting nose, it is snapped off and removed—if no dumb-bells exist, then the tiny aperture must be located—slightly dilated by the point of the forefinger, and if possible the stone must be freed in its sac. A caisson or speculum should then be passed on to the aperture, a beam of light thrown along the channel to expose the white surface of the stone, a blunt graving tool or chisel being guided on to it under control of the eye. The assistant now passes his finger into the rectum, and supports the stone from behind, while the surgeon steadies the point of the chisel on the stone, and taps its head smartly with the mallet. The stone is fractured, as it is chiefly phosphatic material. With a little manipulation the stone is turned. another section is made, and so on, until the pieces can be safely pulled through the orifice of the sac into the caisson and out."

The question now arises of closing the opening with sutures or leaving it open. in part at least.

The drainage of the bladder by a catheter, in the urethra, or by suction and syphonage (p. 383) is so difficult, the patient's condition so very unsatisfactory* for the first week or so, owing to the constant soakage in spite of voluminous dressings, that wherever it is possible the bladder opening should be closed by sutures. One of the first to adopt this plan successfully was Dr. L. S. Pilcher, of New York: a catheter was used till the ninth day, the patient, an adult, went out on the fourth, and on the fourteenth day was shown to the New York Medical Society, primary union having taken place throughout the whole extent of the wound, without unpleasant symptoms of any kind. Mr. R. W. Parker had an equally successful case in a child aged 3. There have been a number of others. Mr. Anderson, of Nottingham (*Lancet*, vol. i. 1890, p. 898), sutured the bladder in a boy aged 10. Acute pneumonia complicated the after-treatment, and on the night of the fourth day (the superficial sutures being removed and the wound healed) prolonged coughing tore open the wound. The case did well. Mr. Pollard described three cases in which the bladder was sutured after supra-pubic lithotomy in children. Urine leaked through in each case on the third day. All did well. In a very interesting paper by Mr. Bond, of Leicester (*Lancet*, vol. ii. 1889, p. 260), it will be seen that in three out of four cases in which the bladder had been sutured, some urine escaped once about twelve hours after the operation. This did not delay the union. A single row of

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* This is especially the case in elderly flabby patients with damaged kidneys, and unsatisfactory vital power and will. Such tend to become apathetic, to lie helplessly on their backs down in the bed, thus easily getting stasis in their lung bases and broncho-pneumonia, together with a low septic condition of the wound. The nursing of such cases is greatly helped by suture of the wound, and thus keeping the patients dry.

Lembert's sutures put in efficiently (p. 228) will suffice. If a double row is used, the mucous membrane is first drawn together by a continuous suture of chromic gut, and then some interrupted sutures, not going deeper than the muscular coat, are introduced.

Sutures should not be employed (1) where there is cystitis, and the urine ammoniacal, (2) where the bladder is irritable, thickened, and the better for drainage, (3) where the extraction is difficult and prolonged, and the parts necessarily bruised, (4) where there is any reason to expect bleeding; in such cases the clots will cause violent tenesmus, and, probably, giving way of the sutures, (5) where there is any stricture or an irritable condition of the urethra sutures are inadmissible.

Where sutures are not used, in order to prevent extravasation, the cut edges of the bladder should be sutured with fine catgut to the fascial and deeper edges of the wound, two or three sutures being placed on either side, and one below at the lower end of the incision so as to shut off the tissues behind the pubes.

Two or three buried catgut sutures then draw the linea alba together above, the edges of this having been trimmed and pared, while three or four more unite the skin. Iodoform and collodion should be brushed over the united portion of the wound, and the bladder should be drained by Mr. Cathcart's method (p. 383). If this has not been provided, a large Thomson's supra-pubic tube should be inserted, and every attempt made by a regular supply of dry dressings, and, after the first twenty-four hours, turning the patient on his sides for a few hours alternately, to prevent any part becoming sore from the constant soaking. But if the bladder is not sutured, only some such method as Mr. Cathcart's will keep the parts dry and save the patients from the great risk of extravasation. Where sutures are used it will be well not to unite the linea alba and skin below. For the first few days it will be unwise to trust to the patient's voluntary power of expulsion, and if the catheter becomes plugged, or if it is not passed just when required, some urine, possibly septic, may be forced out between the sutures before the bladder wound is finally closed, a process which must take two or three days. If this extravasation take place deep down in a wound like this, where the superficial parts have been closed, there is the gravest peril of a fatal issue from septic purulent infiltration of the connective tissue of the cavum Retzii, pelvis, and abdominal wall.

A few words may be said here about *the peritonæum*. With such distension of the bladder as has been advised, with an incision not begun too high up and carried well down over the pubes, with a moderate incision into the bladder, it is most unlikely that anything will be seen of the peritonæum. It may be very indistinctly felt at the upper part of the wound, but this is, usually, all.

If, after careful distension of the bladder the peritonæum still seems to encroach too far upon the anterior surface of the bladder, it may be pressed upwards and held out of the way by one or two fingers of an assistant, or, if needful, gently peeled upwards off the bladder with a steel director.* In elderly people with lax tissues and large stones requiring free incisions, the peritonæum covered with its fatty tissue is more likely to be seen rising and falling in the upper angle of the wound.

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* In only three of my fourteen cases did I have any trouble with the peritonæum. To give one instance, in an elderly patient of Dr. Bell's, of Blackheath, with two lithic acid calculi each weighing 1 oz., the peritonæum almost reached the level of the

If, what is most unlikely with the recent improvements in the operation, the peritonæum should be punctured before the bladder is opened, the puncture should be picked up and tied around with fine silk or chromic gut. If the opening is more than a puncture the cut edges of the peritonæum should be sutured to the edges of the external wound, and the bladder not opened for three or four days (Bruce Clarke, *Brit. Med. Journ.*, vol. i. 1890, p. 240).

If the opening is made after the bladder is opened, the surgeon must decide, according to the amount and character of the urine which has escaped, between suturing the opening and enlarging it upwards, so as to thoroughly sponge out or cleanse by irrigation with a 2 per cent. solution of boracic acid, the peritonæal cavity. But these accidents are most unlikely nowadays.

I have now operated by this method fourteen times in the last few years, the patients ranging from 3 to 62 years. Four only of the stones were large. Two were just over 2 oz., a third was 5 oz.; in the fourth, a young woman, the stone, formed round a hairpin, weighed 6 oz. In five they were multiple. In seven the urine was alkaline and foul. Four cases were fatal—the sixth, a lad of 19, an orphan, in wretched condition of body, and in much misery from pain. Perhaps I should have done more wisely to have waited longer, in order to feed him up before operating. His pain, however, was so severe that I operated a week after his admission into the hospital. He did excellently for forty-eight hours, then symptoms of pelvic cellulitis set in, proving fatal on the fourth day. The other case was one of multiple stones in a man of 58, much run down in strength. I removed eight calculi, composed chiefly of urates. The patient sank shortly after. His kidneys proved to be in an advanced stage of granular degeneration. Two other patients, elderly men, died of kidney failure, one on the fourth day, the other twenty-two days after the operation.

While on some points connected with the operation my mind remains open, I am strongly of opinion that, with carefulness, it is a safer operation than the lateral method for those who only perform lithotomy occasionally, and for large stones—*e.g.*, over 1 oz. I am certain that no benefit is to be gained by substituting it for the lateral in the case of children.

MEDIAN LITHOTOMY.

Disadvantages.

1. It gives very little room, and is unsuited to any save the smallest stones. 2. The wound being small, the surgeon cannot bury his

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symphysis. It was, however, easily detached from the bladder and held up with a retractor. I closed the upper part of the wound carefully over it, and sutured the edges of the bladder to the deep part of the wound. A good recovery followed in this and the other two cases, which were similar. At the Congress of German Surgeons in 1886, Gussenbauer, Sonnenberg, and Kramer mentioned cases in which the peritonæum was found adherent to the symphysis. In one case it was opened with fatal results; in another, the opening was sewn up and the peritonæum safely separated from the pubes.

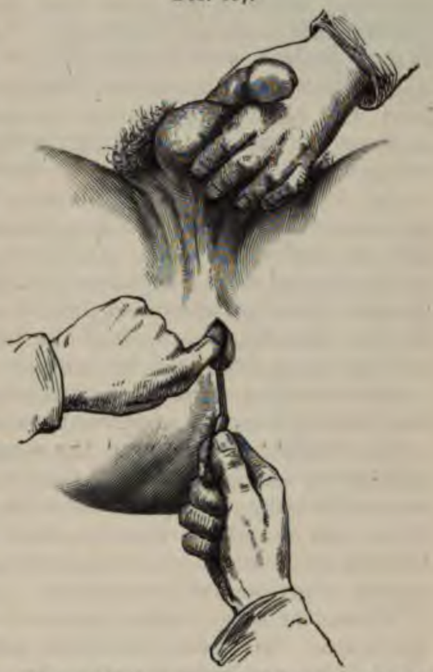
knuckles in it, or reach the bladder as easily as in the case of the larger lateral wound (Cadge). 3. The rectum on the one hand, and the bulb on the other, are in greater danger than by the lateral method (Cadge). 4. Troublesome bleeding is more frequent (Cadge).

Mr. Cadge, having operated on fifty or sixty cases by the median method, has given it up for the above reasons, and also because his mortality has been rather higher.

Advantages.—Recovery is often extremely rapid; the urine quickly resumes its natural route; and the wound, instead of gaping and healing slowly as the lateral wound does, heals almost by first intention.*

The above do not, however, compensate, in Mr. Cadge's opinion, for the disadvantages. He would avoid it, especially in children, in whom it is by some preferred, as in them a free incision is necessary to facilitate the passing of the finger into the bladder, while here the limit of space for the knife is very small indeed.

FIG. 167.



Median lithotomy. The left fore-finger being introduced along the director, which was passed into the bladder before the withdrawal of the staff. (Heath.)

The operation is suited for prostatic calculi, but, if these are associated with any larger one in the bladder, the surgeon must either crush this before he can extract it through his small incision, or perform a supra-pubic operation.

Operation.—If a curved† staff be used, one with a wide groove is chosen, and passed and held with its handle inclined towards the umbilicus (p. 394), the patient being in lithotomy position. The surgeon passes his left forefinger into the rectum so as to steady with its tip the staff in the membranous urethra and also to guard the rectum from puncture, while at the same time note is taken of the depth of tissues between the knife and the finger. A straight and very sharp bistoury is then pushed, with its back downwards, through the skin, half an inch above the anus, straight on into the groove in the staff, which is now held well hooked up against the pubes. The knife, having distinctly exposed the groove, is pushed a little onwards so as to nick the apex of the prostate, and next, as it is withdrawn, it is carried upwards in the raphé so as to divide the soft parts for one inch or more, according to the size of the stone. The finger would now be passed into the bladder, and the staff withdrawn. As, however, the staff occupies too much room in the limited wound to allow of this, a director is passed in along the groove, the staff withdrawn, and then the finger introduced along the director through the neck of the bladder. This is dilated sufficiently, and the scoop or forceps introduced.

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* Dr. W. T. Briggs, of Nashville (*Trans. Amer. Surg. Assoc.*, vol. v. p. 127), thus sums up the advantages of median lithotomy: (1) It opens up the shortest and most direct route to the bladder. (2) It divides parts of the least importance. (3) It is an almost bloodless operation. (4) It affords a passage for any calculus which can be safely extracted through the perinæum. (5) It affords the best passage for the fragmentation of unusually large calculi. (6) It reduces the death-rate to a minimum. In answer to the objection to the median operation that it is unfitted for the extraction of large stones, Dr. Briggs states that by making it a medio-bilateral operation (*vide infra*), as large stones can be removed by it as can be extracted by the lateral method. Since adopting the above modification, Dr. Briggs has had the following excellent results: Of the first seventy-four, none died. Then two died, but one of these had a pelvic abscess before the operation, and the other died at the end of three months with phthisis, and the wound unhealed. Since then Dr. Briggs has had forty-six cases with one death.

† Mr. Erichsen recommends a rectangular staff, the angle of which rests against the apex of the prostate, and is thus much easier to find in the perinæum. The special staff is, however, often difficult to introduce, and a curved one, held so as to project its curve in the perinæum, will be easily found.

Some surgeons prefer to make the incision from above downwards, but cutting from below upwards would seem better to protect the bowel.

If a straight staff be used, the surgeon introducing his knife as above, and having cut upon the staff distinctly both to himself and the assistant who is holding it, takes it into his left hand, and, having brought it down into an oblique position, runs his bistoury along the groove so as to nick the prostate; the enlargement of the wound and the rest of the operation are conducted as above.

Where the stone is too large to be extracted by the ordinary median operation, the **medio-bilateral modification** introduced by Gouley, 1828, and used so successfully in America by Dr. Briggs, should be employed. It consists in making, after a longitudinal incision in the raphé, a slight bilateral cut in the elastic ring at the neck of the bladder and the prostate.

Complications and Causes of Death after Lithotomy.—1. Shock. —This is rarely severe, save in patients much pulled down, and after prolonged operations. Children, as a rule, however reduced,* rally well after the operation (Sir J. Paget, *Clin. Essays*, p. 404). 2. Hæmorrhage.—If milder methods fail this is best met by plugging the wound with the umbrella-plug, or by leaving *in situ* a pair of Spencer Wells's forceps, which will also aid the drainage. 3. Pelvic cellulitis.—This, the most frequent cause of death, is due either to extravasation of urine, probably septic, or to laceration of the deep parts, or both. It usually comes on within forty-eight hours. 4. Peritonitis.—Usually combined with the above. 5. Septic complications.—Septicæmia may occur early with pelvic cellulitis. Pyæmia, on the other hand, may come on later. 6. Surgical kidney. 7. Retention of urine.—Common enough a few days after, from swelling of the parts. Rarely more serious 8. Suppression of urine. 9. A sloughy, phosphatic state of the wound. 10. Sloughing of the rectum (p. 396). 11. Cystitis.—Rare. 12. Epididymitis. 13. Such causes as tetanus. Later complications rare, but troublesome. 14. Fistula. 15. Incontinence. 16. Sterility.

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* Occasionally, however, even nowadays, where the history is of long standing and the kidneys much impaired, they are too far gone for operation. See a case by Mr. Hutchinson (*Clin. Surg.*, pl. lxxvi. vol. ii. p. 126).

LITHOTRITY—OPERATION WITH SEVERAL SITTINGS—RAPID OPERATION WITH ONE SITTING AND EVACUATION—LITHOLAPAXY—PERINÆAL LITHOTRITY.

Choice of Operation—Lithotrity or Lithotomy.—It is hoped that the following points, while they do not in the least exhaust the subject, will be found of practical assistance:

1. Amount of experience of the surgeon.—Every attempt should be made to become familiar with the use of the instruments, both outside the body and also by passing a lithotrite for examination of a calculus whenever one is felt on sounding. No surgeon who has not had abundant opportunities of practising the needful manipulations will do wisely in attempting to crush a hard stone which weighs an ounce.

2. Size, kind, and number of stones.—As to size, up to 1 oz. or 1½ oz., it is probable that, with the majority of stones, in fairly practised hands, lithotrity is immensely superior to lithotomy as far as immediate mortality is concerned. I use the term "immediate" advisedly, because of the more frequent recurrence, with its results, after lithotrity, and would refer my readers to the remarks on this point at p. 412. Much larger stones may be successfully crushed by an experienced operator with the specially strong instruments now made. Freyer (*Lancet*, Dec. 12, 1896) gives a list containing thirty-one cases in which the stone averaged 2 oz. 5 drs. in weight, all of which were successfully crushed. The largest stone which Freyer has crushed weighed 6⅛ oz., the operation lasting two hours. The same author, moreover, considers that in all cases trial should be made of litholapaxy before a cutting operation is performed.

Mr. H. Milton ("Lithotrity, Simple and Complicated," *Lancet*, April and May, 1896) records an epoch-marking case in which he crushed a stone (urates and phosphates) weighing over 12 oz. The operation lasted two hours, and an especial lithotrite with a gape of five inches was used. Such an operation is, of course, only possible for an expert with especial experience, such as Mr. Milton's in Egypt. This surgeon had before (*St. Thos. Hosp. Reports*, 1891) referred to the extraordinary tolerance which Orientals show to all operations connected with the genito-urinary apparatus.

The difficulty of a decision sometimes met with here is well expressed by the words of Sir W. Fergusson, that the greater is the experience of the surgeon the greater will sometimes be his doubt.

To anyone with very limited experience rashly contemplating an attack upon a hard stone I would recall Mr. Milton's words (*loc. infra cit.*): "During the first twenty minutes of a long crushing most men can maintain the necessary delicacy of manipulation, combined with the exercise of considerable force; but when it comes to working at the same strain for a second, third or fourth, or even fifth, sixth or seventh period condition begins to tell . . . . this force has to be exerted with the greatest discrimination and the greatest patience." In addition to the above must be remembered the frequent introduction and withdrawal of instruments, lithotrite and evacuators, and the result upon the neck of the bladder and the deep urethra.

More important than the size of the stone is its composition. There is, of course, no comparison between a pure lithic acid or oxalate of lime stone on the one hand and an alternating stone with a good deal of phosphate or urates in its composition, as a test of skill and endurance both on the part of the surgeon and his instruments. Dr. Hingston, of Montreal (*Intern. Encycl. of Surg.*, vol. vi. p. 311), in his article on Lithotrity, points out that sometimes the apparent softness of a stone is most misleading.

Having found an enormous stone in a patient, he employed lithrotity, as the stone seemed soft. After getting away a large quantity of phosphatic matter, he was driven to perform lithotomy, and removed, by the lateral method, a calculus weighing over 5 oz., consisting mainly of oxalate of lime and uric acid.

There are several other *fallacies in gauging the size and number of calculi.* Thus the lithotrite may again and again seize a stone which only weighs ½ oz. in its long diameter, if flattened, of two inches. Testing by passing a staff around or rubbing it over a calculus is often most fallacious, and examining per rectum may, if the bladder be thickened, give evidence of a stone apparently much larger than it really is. Mr. Cadge (*loc. supra cit.*) points out a fallacy with regard to multiple stones. "When more than one stone is present, it is customary to seize one, fix it in the instrument, and proceed to sound afresh; this, however, may mislead, for a stone, having been grasped by the tips of the blades and moved about in the bladder, will sometimes rotate a little in the blades of the lithotrite and communicate a grating feel to the hand which is very like touching a second stone."

3. Condition of the urethra.—Two points have to be considered here—(*a*) how far will the urethra *admit* instruments—*i.e.*, how far is its canal normal or diminished by stricture; (*b*) how far, even if normal in calibre, will the urethra *tolerate* instruments. With regard to the first, a stricture, if admitting of dilatation, is not an obstacle to lithotrity; on the other hand, an old stricture with surrounding induration and fistulæ, or a less severe form which produces rigors and fever at each attempt of dilatation, are best submitted to lithotomy, which gives the best chance for the stone, and at the same time offers the much-needed relief of rest to the stricture. Mr. Cadge gives the following practical hint in these cases of stone combined with stricture: "Sometimes a stone is detected in the urethra behind the stricture, as well as one or more in the bladder, or it may be partly in the bladder and partly in the urethra, and in these cases median lithotomy will not only remove the stone, but may go far to remedy the stricture by external division."

With regard to an irritable urethra—*i.e.*, one without a stricture and only admitting instruments with the aid of anæsthetics—the chief points to consider are the size of the stone and the ability of the surgeon to deal with it by litholapaxy. If the calculus cannot be evacuated at once, or requires more than one sitting, lithotomy should be preferred, owing to the results of the passage of instruments and prolonged voiding of fragments.

4. Condition of the prostate.—An enlarged prostate is of great importance, not only from its power of obstructing the operation, but from the changes which it brings about in the bladder. Thus, it interferes with the efficient use of instruments, the picking up of a stone even with the blades reversed, and the finding of the last fragment. Again, the use of the lithotrite and the passage of evacuating tubes readily lead to hæmorrhage, and this again by clots prevents the free and easy use of the evacuator. Later on, phosphatic deposit, imperfect evacuation, residual urine, and recurrence of stone symptoms are all frequent accompaniments of enlarged prostate.

5. Condition of the bladder.—Formerly it was held needful to operate with several ounces of fluid in the bladder, and some suggested to draw off the urine and inject 8 or 10 oz. of fluid. This amount has now been reduced to something more like 4 or 6 oz. As, if the urine is healthy, no fluid is more suited to the bladder, the surgeon should content himself with following Sir H. Thompson, and "ask the patient to retain his urine for a little less than his accustomed period before the sitting; that is, if he is naturally able to retain his urine for about an hour, he is requested to pass it forty minutes before the time of the visit."

Some other changes* in the bladder require mention. (*a*) Sacculation pouches or sacs, whether mere hollows behind or at the sides of an enlarged prostate, or hernial protrusion of the mucous membrane between the muscular fibres, may be the starting-point of calculus by entangling *débris* or tiny fragments. In Mr. Cadge's words: "The imprisoned fragment first fills up the cyst, then, by continual accretion of phosphates, it grows up into the bladder like a mushroom, and is probably again and again nibbled off by the lithotrite, each time with temporary benefit, until the patient dies, worn out with chronic cystitis and pyelitis." Mr. Cadge goes on to say: "By turning the aperture of the evacuating catheter towards these pouches, and by the free use of the aspirator in all directions, the fragments may be washed out of them and all removed, but it cannot be denied that it is always a serious matter to shatter a stone into innumerable fragments in a bladder of this description." (*b*) Atony, whether with or without an enlarged prostate. The importance of this is obvious, as tending to recurrence of stone by some small fragments not being expelled in spite of the vigorous use of the aspirator, and also to cystitis from imperfect emptying of the bladder.

6. Condition of the kidneys.—Here I may again quote a veteran's opinion, that of Mr. Cadge: "What is to be said of stone complicated with kidney disease, such as albuminuria and chronic pyelitis and atrophy? In these cases all operations are fraught with danger, but it is probable that the least danger will be met with from a carefully conducted one-sitting lithotrity. So, too, in those cases of constitutional

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* Several allied conditions exist in which the position of the stone is complicated with difficulties—*e.g.*, (1) where the stone has been partly in the bladder and partly in the urethra. (2) The stone has been lodged entirely or partly in a diverticulum of the bladder. (3) The stone has been lodged in a deep pouch behind the prostate. For helpful information on these and many other points I would advise my readers to consult Mr. H. Milton's paper on "Lithotrity in Cases of Stone, Simple and Complicated," *Lancet*, April and May, 1896.

disease combined with stone, such as diabetes, tabes, and other spine disease, it will be well to avoid the shock and hæmorrhage of lithotomy, and proceed, if any surgical proceeding is allowable, by lithotrity." The surgeon, in considering an operation in any of the above diseases, will weigh well the size of the stone, his ability to cope with it at one sitting, and the amount of suffering which it causes the patient.

7. Age.—Here, especially, age is not to be reckoned by years alone.

Recurrence.—As no one, to my knowledge, has spoken out on this subject with such helpful candour as Mr. Cadge, with his experience of 300 cases of stone, I make no apology for quoting once more from his writings (*Brit. Med. Journ.*, July 3, 1886): "Although the immediate and direct mortality of lithotrity is small, the recurrence of stone is lamentably frequent. In my own list of 133 cases, there were eighteen in which recurrence, one or more times, took place, being about one in seven. Sir H. Thompson, with a much larger number of cases, gives about the same proportion. I am disposed to infer, however, that recurrence is more frequent even than this, because it is not likely that all who get relapse apply to the same surgeon again. Living, as I do, in a local centre, and drawing cases chiefly from a limited area, I am probably more able to trace, and more called on to treat those who suffer a second and third time, than he who lives in the metropolis and draws his cases from great distances. Patients may, and frequently do, apply to the same operator once or twice; but, after a time, they either apply to their own surgeon, or they decline further treatment, and too often their subsequent history is one of painful endurance of chronic bladder disease and gradual exhaustion. If, moreover, there be added to the list those numerous cases of phosphatic deposit or concretions so frequently noticed after lithotrity, the relapses would, I believe, reach to nearly 20 per cent. This seems a heavy indictment to bring against lithotrity, but I am afraid there is no gainsaying it; and, if so, it would be wrong to pass it over or make light of it. Many of these relapses might be prevented if the patients would observe directions and persevere with treatment. It certainly is so with the unenlightened and uncomplaining hospital patient. Feeling himself well, or what he considers well, he goes to his work, and neglects the use of the catheter and other means; and, instead of returning in a month or so to have his cure certified, or a minute remaining fragment removed, he toils away as long as he can, and returns, perhaps in a year or two, with a fresh uric-acid stone, or with chronic cystitis and a phosphatic one. The educated, sensitive private patient, on the other hand, will watch his symptoms narrowly, and return if the slightest indication of the old mischief should reappear. . . . . This frequent recurrence must be due either (1) to the descent of a fresh stone from the kidneys, or (2) to a fragment of stone having been left at the first operation. As to the descent of a fresh stone: there can, of course, be no doubt as to the occasional occurrence of this cause, just as we see it occur after lithotomy. The bladder being entirely cleared of stone, there will be the same liability to the descent of a fresh renal calculus after one operation as after the other. What then, let me ask, is the fact as to lithotomy? I have already shown that there were only twenty-one cases out of more than 1000 of lithotomy at the Norwich Hospital in which recurrence was clearly traced to perfectly fresh formations, coming, like the first, from the kidney, or about one in fifty; whereas, in Sir H. Thompson's list of about 600 persons treated by lithotrity, he mentions sixty-one cases in which he operated twice; nine, three times; three, four times, and two, five times—seventy-five in all, or about one in eight. The inference from these data seems to me to be inevitable, that relapse of stone after lithotrity is chiefly due to other causes than the descent of a fresh stone. To my thinking the majority of recurrences is caused by the great difficulty in ensuring the complete removal of all the *débris*; I have already referred to this in old persons with enlarged prostates and feeble atonic bladders, and it is this class of patients who are especially liable to relapse." Mr. Cadge goes on to show that the tendency to phosphatic deposit after lithotrity is not due to vesical incompetence and residual urine alone without some overlooked fragment, and that the improved method with repeated washings will still fail to discover a last fragment in some bladders.

More recently Mr. Reginald Harrison has given (*Lancet*, Nov. 12, 1899) an analysis of 110 operations for stone, 101 of which were litholapaxies. Recurrence, necessitating further operation, took place twenty-three times, *i.e.*, in nearly 23 per cent., a considerably greater proportion than Mr. Cadge gives. In all but one case the recurrence was associated with enlarged prostate. Mr. Harrison considers that this is accounted for in several ways, partly by the fact that *débris* may be left behind in sacs and pouches at the time of operation, and partly owing to the inability to completely empty the bladder later, so that fresh stones descending from the kidneys are retained while other foreign bodies, such as shreds and sloughs from an inflamed bladder, may form nuclei for the formation of fresh stones. With a view to preventing recurrence in these cases, the author lays great stress on the importance of thorough washing out at the time of operation, also once a week for three or four months after the operation, and also of the adoption of measures aiming at the reduction of the size of the prostate.

Operation (Figs. 168—171).—The preparatory treatment has been much simplified. It is now recognised that the best course is to remove the stone at once: previous passage of sounds, and injections of the bladder,[*] are now but little used. A few days' rest, bland, unirritating liquid diet, urotropine if there is cystitis, mild aperients, and securing sleep are the chief indications.

The instruments required will be gathered from the following account: The patient having been anæsthetised and lying on a firm couch or mattress close to the right side of the bed or table, with his pelvis raised, and the body and limbs well protected from chill, the surgeon, standing on the right side with his instruments close to him, introduces his lithotrite. In doing this care must be taken not to get the blades hitched either just in front of the triangular ligament or in the roof of the prostatic urethra. This will be secured by not depressing the instrument till very late—in fact, not till it is just about to enter the bladder. The instrument, well warmed and oiled, is held at first horizontally over the groin or abdomen, the penis being drawn over it, the shaft being all the time gradually brought into the vertical position as the instrument finds its way by its own weight into the bulbous, membranous, and prostatic urethra. Now, and not before, the handle is somewhat depressed, and the instrument glides quickly into the cavity of the bladder. If the prostatic urethra is enlarged and lengthened, the surgeon may think that he has reached the bladder, but the fact that the gentlest lateral movement of the lithotrite is interfered with will show him his mistake. Pressure with the instrument is alone allowable at the meatus; some rotation may be called for in guiding the instrument through the triangular ligament or past an enlarged prostate. In this latter case also the handles must be further depressed, and a finger in the rectum may give help.

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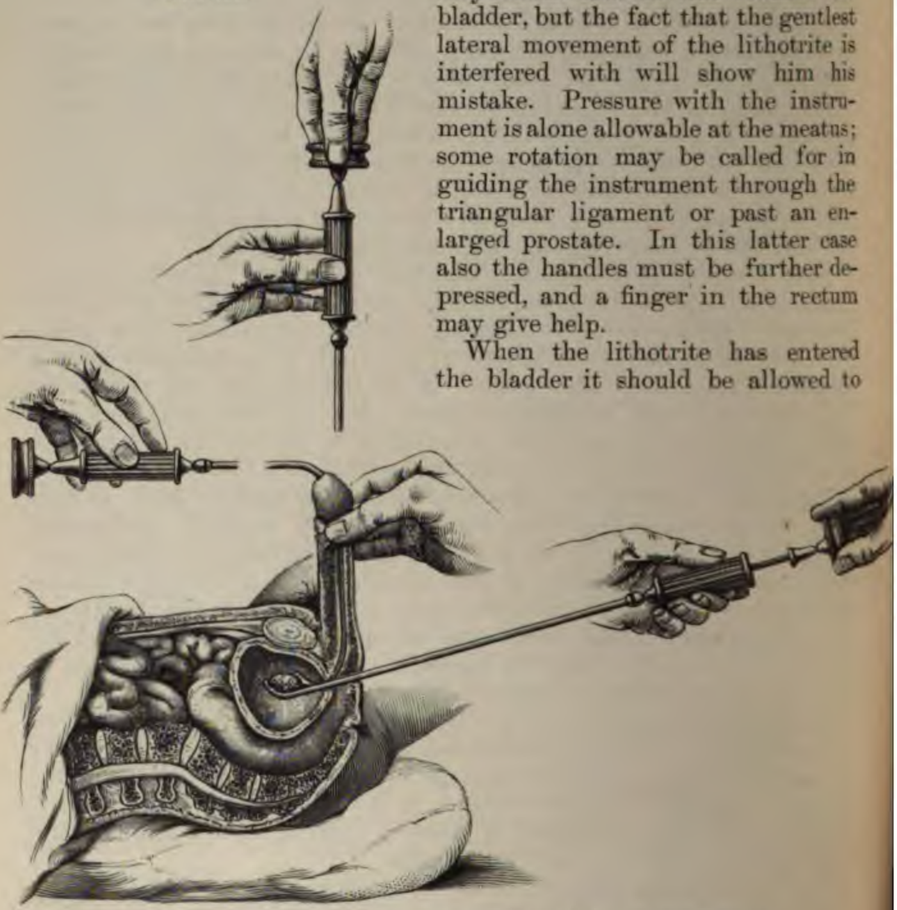
[*] The amount of urine to be held, in most cases, has already been mentioned (p. 411).

When the lithotrite has entered the bladder it should be allowed to slide, very gently, down the trigone, being now held very lightly so as at once to detect the site of the stone, which it now often touches, but must not displace.

Fig. 168.



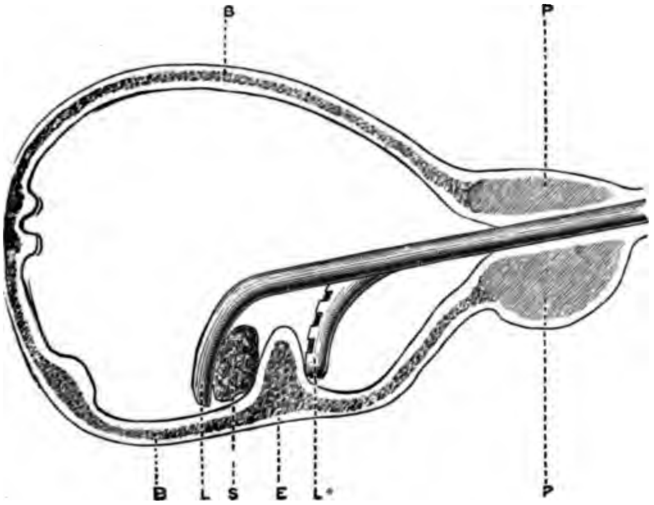
Lithotrity, showing the position of the lithotrite during introduction, grasping the stone and crushing. (Heath.)

If the stone is felt on one side, the instrument is gently turned to the opposite one, opened, and then turned towards the stone. If it be not felt, the handle of the instrument being slightly raised, and the blades very gently depressed and then opened, the stone will often drop into them.

If this fail, the instrument is turned, open, first obliquely, then more horizontally, first to the one side, then to the other. In the event of the stone still eluding the lithotrite, which is most unlikely, it should be sought for with blades depressed. To effect this, the blades, closed, are raised off the bladder floor by depression of the handle, carefully reversed, and then depressed again so as to sweep lightly over the floor. They are then gently opened and closed, vertically first and then obliquely, so as to complete the examination.

During the above, the following points must ever be borne in mind: (*a*) The handle and shaft of the lithotrite are to be kept as steady as possible, so as not to jar the sensitive neck of the bladder needlessly. (*b*) All movements are to be executed at or beyond the centre of the vesical cavity, the proper area of operating, without hurry, rapid movement,[*] or any other which partakes of the nature of a jerk or concussion (Sir H. Thompson, *loc. supra cit.*, p. 296). (*c*) The male blade is never to be brought into contact with the neck of the bladder, unless this is rendered necessary by the position of the stone.

FIG. 169.



This shows a risk present in operating in trabeculated bladders. While the female blade (L) is in direct contact with the stone (S), the male (L*) is in contact with a ridge of the mucous membrane (E). B, Bladder. P, Prostate. (R Harrison.)

The stone being seized by one of the above manœuvres, the button[†] moved, and the screw connected—the screw is gradually turned at first to make the jaws bite, since a sharp turn at this time may drive the stone out either to right or left—the calculus is then carried to the centre of the cavity, which will show whether a fold of mucous membrane has been seized (Fig. 169). As the screw is applied more and more forcibly, one or other of the following will be noticed. If not well caught, and if hard, the stone will be pushed out of the jaws; if hard and well gripped, it is felt to split into fragments; if soft, and held, it crumbles down. If extremely hard, as a pure lithic acid or oxalate, any attempt at advancing the screw is met by this distinctly recoiling instead of advancing. Each surgeon must now decide for himself, according to his knowledge of his instruments and reliance on his power to deal with large, hard fragments, whether to continue or at once to perform lithotomy. If he continue, the resistance will be felt to give way, in the case of a very hard stone, by a sudden sharp crack; in one less hard, more gradually. If the stone does not crack, Freyer (*loc. supra cit.*) advises that the lithotrite be unscrewed, the stone caught in another axis, and the lithotrite again screwed home. By repeating this, if necessary, the stone will usually at last give way. The same surgeon also recommends that in dealing with stones which are more or less round and so large that the lithotrite will not lock in any direction, the jaws of the instrument should be dug into one side of the stone and screwed up, a portion of the crust being thus broken off. By repeating this a number of times, sufficient reduction in size will take place to allow of the lithotrite being locked on the stone. In overcoming much resistance the surgeon either screws up the male blade as hard as he can and keeps it so, or, having gently unscrewed it a little, screws it up again with a series of light jerks so as to communicate blows to the stone. Cracking of the stone having taken place, the fragments will usually fall close to the original site. Thus the lithotrite has only to be kept as immovable as possible to ensure, on drawing out and again closing the male blade, the seizure of a fragment.* This is crushed, and the process repeated again and again till sufficient *débris* is formed. The lithotrite is then withdrawn firmly screwed up.

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[*] "Rapid movements produce currents which keep the stone more or less in motion, so that it is less easily seized than when the surrounding fluid is in a state of rest" (Thompson).

[†] In this respect Prof. Bigelow's lithotrite seems inferior to Sir H. Thompson's, the working of the button in the latter being smoother and less vibrating.

A straight or curved evacuating tube, No. 16 for a stone of moderate size, and 18 for a large one, is then introduced, the evacuator, filled with a warm solution of boracic acid or dilute Thompson's fluid (p. 402), is connected, the meatus being first incised with a narrow probe-pointed bistoury downwards by the side of the frænum, if needful. The tube, if curved, should be held downwards at first, but not quite on the bladder floor; then to one side or the other; then upwards, washings being carried on at the time that these movements are made. A straight tube should lie with its orifice just within the neck of the bladder. Dr. Keyes (*Intern. Encycl. of Surg.*, vol. vi. p. 244) gives this precaution as to getting rid of air entirely: "The urine, having trickled away through the tube, leaves the latter full of air, an element fatal to nicety of washing. This air may be disposed of most simply. The tube is withdrawn until its eye is in the prostatic sinus, the washing-bottle is attached, and the stop-cock turned, but no further suction made. In an instant, the air contained in the tube is heard ascending through the stop-cock and mounting into the top of the evacuator, where it does no harm, and whence it cannot possibly return into the bladder." While his left hand supports the evacuator, with his right the surgeon gently but quickly squeezes the bag with sufficient force to send in about two ounces of fluid. On relaxing the pressure an outward current takes place, bringing with it crushed fragments. Sir H. Thompson recommends that, after the bag has expanded and the current apparently ceased, the surgeon should wait a few seconds, "as at that precise time it is quite common for one or two of the larger fragments to drop into the receiver which would have been driven back, perhaps, by too rapidly resuming the pressure."

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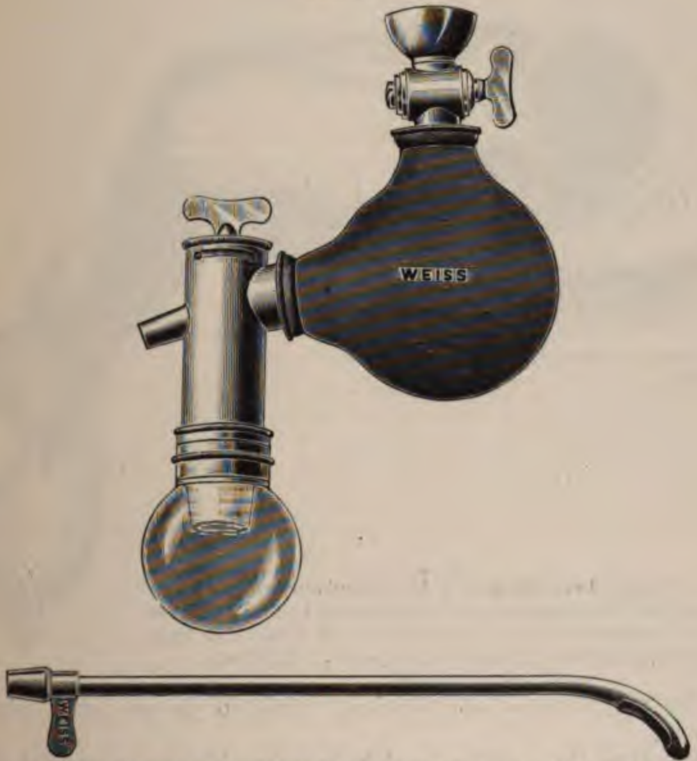
* It is not always easy to distinguish between a piece of soft stone enveloped in inspissated mucus and the lining membrane of the bladder.

If, after several washings, the outflow stops, and the bag no longer expands, the end of the evacuator is blocked either by a fragment of stone, or a small calculus, a clot of blood, or the mucous membrane of the bladder. If it be a fragment, as is usually the case, or a clot, dislodgment may be effected by sending in quickly a gush of fluid, or by the use of a gum-elastic stylet, after unscrewing the tube. Impact of the bladder generally takes place when a curved evacuator is turned

Fig. 170.



Sir H. Thompson's aspirator, last pattern but one. (Freyer.)*

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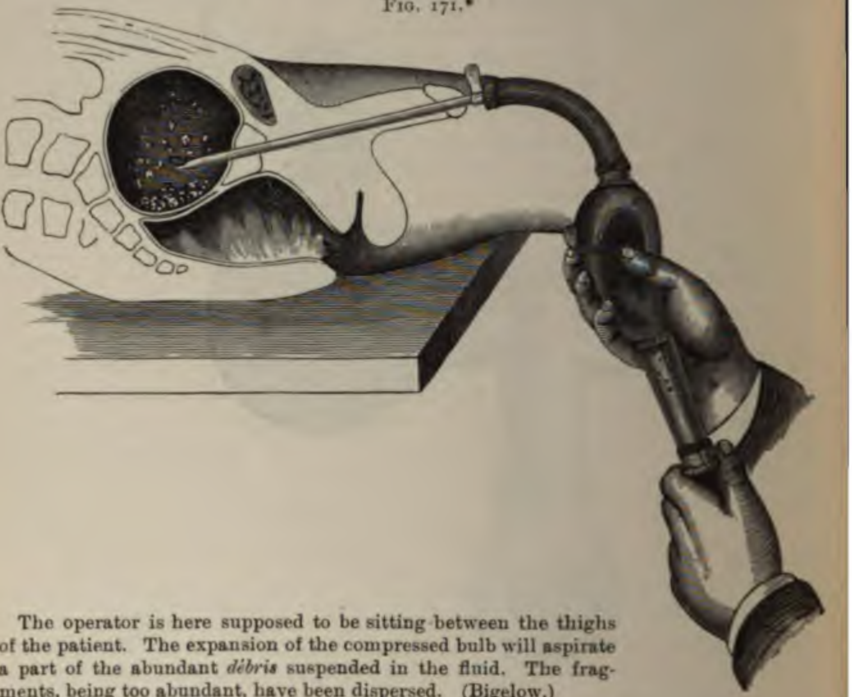
* Of this instrument Dr. Freyer writes (*Litholapaxy*, p. 25): "I must confess a great liking for Thompson's instrument. One of this variety made for me by Messrs. Weiss I have worked with for four years, and though it has assisted at 130 operations, and been through three hot weathers in the plains of India, it is still as efficient as much newer instruments I possess, a fact which speaks well for the india-rubber employed in its construction."

upwards, and when the bladder is empty. The sensation given may be a kind of flap, simulating the click of a fragment; more often it is a dull, vibrating thud, easily recognised. More fluid must be at once injected.

If a large fragment is felt striking against the tube, or if the surgeon is certain that several good-sized fragments remain, he removes the tube and evacuator, and, while an assistant withdraws the blood-stained fluid and fragments, and recharges the evacuator, he introduces a small lithotrite and crushes up sufficient *débris* to go on again with the washings.

Fig. 171.*



The operator is here supposed to be sitting between the thighs of the patient. The expansion of the compressed bulb will aspirate a part of the abundant *débris* suspended in the fluid. The fragments, being too abundant, have been dispersed. (Bigelow.)

All the time the surgeon must keep before his eyes a mental picture of the interior of the bladder, perhaps diseased, the ureters, perhaps dilated, leading up to kidney pelves enlarged, and remember that the effects of any squeeze of his hands are felt, not only all over the bladder, but perhaps in the ureters and kidneys as well.

Detection and Seizure of the Last Fragment.—This is, as is well known, a matter of much difficulty, owing to the facility with which small fragments get hidden in some folds of mucous membrane or enveloped in blood-clot. As long as there is any "clicking" against the tube, the surgeon must persevere in his attempts at complete removal. If, after several washings, nothing comes out into the receiver, the surgeon should listen carefully over the bladder, as thus advised by

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* The above evacuator is now old-fashioned. Mr. Golding Bird's pattern, or the one figured at p. 417, will be found the most handy.

Dr. Keyes:* "The tube is turned in various positions, and the operator listens. The swash of the water as it rushes in and out is heard with startling distinctness, and, if the management of the tube is skilful, any fragment of stone lying loose in the bladder is sure in a short time to be driven against the metallic tube so as to announce its presence by a characteristic click, quite distinct from that emitted by the flapping of the bladder wall against the eye of the instrument. Fine sand and thin scales of stone make no sharp click, and all such may be left to pass by Nature's efforts, but any piece large enough to require the lithotrite can hardly escape detection by the educated ear."

Time occupied in Litholapaxy.—This may be, on an average, from half an hour to an hour and a half. Prof. Bigelow (*Amer. Journ. Med. Sci.*, Jan. 1878) operated continuously for upwards of three hours, removing 744 grains, the patient making a good recovery. Mr. R. Harrison (*Brit. Med. Journ.*, Aug. 10, 1882) removed a two and a half ounce stone in two hours and ten minutes (*vide* also p. 409).

The Old and the New Operation of Lithotrity briefly contrasted.—Old lithotrity advocated short sittings, and brief use of instruments, and left the expulsion of fragments, &c., as much as possible to Nature. It probably requires less skill, and, in Mr. Cadge's words, "is gentler, milder, less formidable altogether; no anæsthetic is probably required; no extra assistance. . . . . A nervous, timid patient may prefer this to the more heroic and rougher, if more expeditious, method." It might be added that it is less tiring to the surgeon. But these advantages are trifling as compared with its disadvantages, which are done away with by the new operation, of which the chief are the prolonged passage of fragments, often rough and angular, along a bruised urethra. Mr. Milton (*loc. supra cit.*) has invented an evacuating lithotrite—a combination of the usual crushing and evacuating instruments, which will be useful in the aged, with a moderate sized and soft stone and enlarged prostate, from the single introduction required.

The new method of litholapaxy, introduced by Prof. Bigelow, resulted from, and was led up to by, several achievements of modern surgery. Without anæsthetics, without the knowledge of the large instruments admitted by the urethra, without the pitch of perfection and power to which modern instruments have been brought, litholapaxy would still be an impossibility. Owing to its brilliant success, and the rapidity with which it relieves the patient, the single-sitting method has practically rendered the other obsolete.

After-treatment.—The chief points here are: rest in bed, the patient turning on his side to pass water, for the first few days; hot fomentations to the abdomen, and hot bottles at first; morphia subcutaneously, if indicated; warm milk, barley-water, mineral waters or lemonade, a little whisky or brandy being given, if needful; all chills should be carefully avoided. Mr. Milton (*loc. supra cit.*) recommends salicylate of soda at first every two and then every four hours if there is fever, and diuretin if there is diminution of urine. In each case the amount given is one gramme. If cystitis is present, urotropine in doses of 5 to 10 grs. thrice daily should be given.

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* *Loc. supra cit.*, p. 246. The whole of this account, with its vigorous life-like language, will well repay perusal.

In addition to the above, the putting the patient frequently in hot hip-baths for a quarter of an hour, the occasional passage of a soft catheter, and the rendering the urine alkaline, will give much relief. The urine should always be strained through muslin to collect the *dêbris*.

It is advisable also to once more thoroughly wash out the bladder with the evacuator a week after the operation, as a safeguard against recurrence from small fragments left behind at the time of operation. Where there is any obstruction, such as an enlarged prostate, Mr. Harrison recommends frequent washings over a prolonged period (*vide supra*, p. 413).

Complications during Lithotrity and Litholapaxy.

1. Escape of Urine.—This may take place during or after the passage of the lithotrite. The penis should be compressed against the lithotrite, and a pause made while the patient is got more fully under the anæsthetic. If this fail, tying a tape round the penis and instrument, injecting a little fluid, or putting off the operation till the bladder is in a more fitting state after the use of instruments, injections, and such drugs as belladonna and subcutaneous injections of morphia, may be made use of. 2. Hæmorrhage.—Sufficient blood to stain the fluid in the evacuator during the operation, and the urine for a day or two after it, is not uncommon. If the hæmorrhage during the operation is severe, the surgeon must decide whether it is due to the damage to the bladder or urethra, to his having scratched the latter by withdrawing a fragment in the evacuator's eye, to bruising of an enlarged prostate, or to co-existent growth. In this last case the supra-pubic operation will probably have to be performed either at the time or later; in the other cases the surgeon must decide on completing or deferring the crushing by the amount he has already effected, his experience, and the amount of the bruising inflicted. 3. Clogging or Fracture of the Lithotrite.—Clogging or impaction is liable to happen with a non-fenestrated instrument with weak and narrow blades. With one properly made, with as broad blades as possible, and the male one blunt, roughened, and laterally bevelled off, the accident is unlikely. When it occurs, it must be met by percussing the instrument, if opening and closing the blades, and thus freeing them in the fluid, is impossible. If the impaction persist, the blades must be withdrawn as far as possible by safely maintained traction. If no force that is wise will withdraw them, they should be cut upon in the perinæum, thrust out, unloaded, and withdrawn, and the rest of the stone removed as by a median lithotomy. If, owing to any defect in the instrument, the blades, though not clogged, cannot be screwed up, they must be cut upon as above, thrust through, and, if possible, filed off. If a blade break off, it must either be caught and withdrawn by another lithotrite, or the patient cut at once. 4. Injury to the Bladder or Urethra.

Complications after Litholapaxy and Lithotrity.—These are much the same as those already given at p. 408, as occurring after lithotomy. The chief differences are the greater liability to rigors and urinary fever, and the greater frequency of epididymitis. Bruising of the urethra has also to be remembered, whether by the instruments, or, after the old-fashioned lithotrity, by the passage of fragments.

PERINÆAL LITHOTRITY.

This operation—first suggested and carried out by Dolbeau—consists essentially of lithotrity carried out through a small median or lateral perinæal incision.

Surgeon-Major Keegan (*Brit. Med. Journ.*, vol. ii. 1897, p. 23) observes "that experience has taught that supra-pubic lithotomy has not fulfilled the early promise of the days of its revival, for the mortality which has followed it in cases of very large calculi occurring among males at the middle period of life is very considerable. There is, therefore, a growing consensus of opinion among surgeons practising in the East, where cases of very large calculi are of frequent occurrence, that perinæal lithotrity, whether median or lateral, will in the near future supersede supra-pubic lithotomy in dealing with this very important class of cases of stone in the bladder." Reginald Harrison (*Brit. Med. Journ.*, Dec. 12, 1896) also recommends the operation, having performed it fifteen times without a death or recurrence. In one case a very hard urate stone, weighing over three ounces, was crushed and removed in about five minutes, an enlarged middle lobe of the prostate being removed at the same time.

Some of the chief points claimed in favour of this operation are: (1) Large stones may be crushed in a short space of time. (2) An enlarged prostate may be dealt with at the same time. (3) It may be performed in cases of stricture or enlarged prostate. (4) It is less severe than the supra-pubic operation. (5) Excellent drainage is provided in cases of cystitis, &c. (6) Digital examination can be made use of to determine whether all the fragments have been removed.

Before it can be decided, however, whether this operation should entirely supersede the supra-pubic operation, further experience must be awaited, particularly with regard to the important question of recurrence.

Operation.—A small median or lateral perinæal incision is made on a grooved staff, as in lithotomy, sufficiently large for the introduction of the finger into the bladder for the purposes of examination. The "giant" lithotrite specially devised by Mr. Keegan (*loc. supra cit.*) is then introduced into the bladder and the stone crushed as in ordinary lithotrity. The fragments may be removed either by means of forceps or an aspirator connected with a specially large evacuating cannula. A tube is then introduced into the bladder through the wound for purposes of drainage.

Mr. Keegan says that the specially strong "giant" lithotrite devised by him, which is of the size of a No. 20 catheter in the stem and of No. 25½ at the angle, "will readily break up a hard calculus weighing six to eight ounces."

LITHOLAPAXY IN MALE CHILDREN.

The advisability of this mode of treating stone has been strongly advocated by Surgeon-Major Keegan,* who, after a wide experience of large stones in India, is inclined to think that the objections usually made to litholapaxy in boys are not valid. Thus: (1) as to the *smallness of the bladder*, the bladder of a boy of even only three or four is, as a rule, quite roomy enough to permit of the efficient working of a small lithotrite and a medium or full-sized aspirator if gently worked. The bladders of boys with stones are, as a rule, healthy, and will stand more distension proportionately to their capacity than the bladders of old men. (2) *The extreme sensitiveness of the mucous membrane of the bladder and urethra.* Mr. Keegan thinks that, with an anæsthetic, this may be safely disregarded. (3) *The liability to laceration of the mucous membrane of the bladder and urethra.* This objection is, he thinks, a theoretical one only. (4) *The small calibre of the urethra.* Mr. Keegan states that not only is the calibre of the urethra in boys of six or eight not very small, but that of boys of only three or four is sometimes very large. As in men, the true calibre of the urethra cannot be told unless the meatus, which is sometimes very small, is incised. Speaking generally, the urethra of a boy from three to six will admit a No. 7 or a No. 8 lithotrite (Eng. scale), and that of a boy of eight or ten will admit a No. 10, a No. 11, and even sometimes a No. 14. "With a No. 8 lithotrite and a No. 8 evacuating catheter it is, I find, quite feasible to dispose of a mulberry calculus weighing between two and three hundred grains in an hour's time."

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* *Litholapaxy in Male Children and Male Adults* (Churchill, 1887); *Lancet*, 1886.

In a recent publication (*Ind. Med. Gaz.*, Aug. 1900) Mr. Keegan gives the results of a series of 500 litholapaxies in boys. He says: "Grouping the 500 litholapaxies together, the work mainly of three surgeons, I find that the average age of the boys operated on was six years, the average weight of stone removed at each operation was ninety-five grains, and the stay in hospital after operation amounted to four days. The mortality, as already stated, was 41, or 2·2 per cent." Of the 500 operations, Mr. Keegan did 239, and lost 5 cases, the cause of death being extensive kidney disease. Mr. Keegan had constructed by Messrs. Weiss a No. 3½ lithotrite, which has done very good work, and advises anyone wishing to give litholapaxy in boys a fair trial to provide himself with a set of completely fenestrated lithotrites running from No. 4 to No. 10 (Eng. scale).

Mr. Keegan insists upon the completely fenestrated lithotrite as being the only perfectly safe instrument to use, as, with any other, clogging of the blades is a very likely and a most dangerous complication.

In discussing, in the first edition of this book, the advisability of surgeons adopting, as a general rule, this method of dealing with stone in male children, I pointed out (1) that one very important matter, the percentage of recurrence after litholapaxy at this age, had been left undealt with by Mr. Keegan; and (2) that such an individual experience, splendid as it is, can scarcely be taken to furnish a rule to those who only meet with stone at comparatively rare intervals. Mr. Keegan has since written on both these points (*Ind. Med. Gazette*, Feb. 1890, p. 40). It will be seen that, with regard to the first point, the fact that recurrence after litholapaxy in boys in India is so very small, is due to the opportunities and experience, absolutely unrivalled and never to be known in this country, which fall to the lot of surgeons in India in treating stone in the bladder. With regard to my second point, that such an individual experience, so different to anything that we meet with here, should not mislead those who only meet with stone at comparatively rare intervals to substitute litholapaxy for the eminently safe operation* which lateral lithotomy has been proved to be in boys, Mr. Keegan, writing as follows, confirms my opinion: "I am disposed to agree with Mr. Jacobson in doubting if in Great Britain lithotomy in male children will be replaced by litholapaxy. And why? Because to render himself familiar with the use of the lithotrite, the surgeon must be afforded frequent opportunities of dealing with cases of stone; and as such opportunities occur only at rare intervals to the majority of hospital surgeons in Great Britain, they will therefore very naturally cling to that operation which is performed by aid of the instrument with which they are most familiar, the scalpel."

Owing to the increasing rareness of calculus in children at the present time, and the fact that, as a rule, isolated cases—and only successful ones—are alone published, it is very difficult to speak definitely about the results of litholapaxy in children in European surgery. I would call the attention of my readers to a paper by Alexandrow (*Deut. Zeit. f. Chir.*, 1891, Bd. xxxii. Hft. 5, S. 6). This surgeon performed lithotrity thirty-two times in boys between 1 and 14 years of age in a children's hospital at Moscow. In twenty-seven the operation was successful; the remainder were fatal, and in three death occurred from injury to the urethra during the operation. Mr. E. Owen, with praiseworthy candour, brought a case before the Medical Society (*Lancet*, vol. i. 1891, p. 665) in which fatal rupture of the bladder had taken place during litholapaxy in a boy aged 4.

TREATMENT OF STONE IN THE BLADDER IN THE FEMALE.

Practical Points.—The absence of any prostate or of a fixed smooth trigone-surface is of importance here, especially with regard to lithotrity. The aid given by a finger in the vagina, the dilatability of the urethra, the association of calculi with foreign bodies, are also well known. It is only occasionally that enlargement of the uterus or prolapse of the vaginal wall of the bladder interferes with the treatment of stone.

Operations.

A. *In Adults.*—We have here the following three methods to consider:

1. **Dilatation.**—When the stone is small—*i.e.*, the size of a filbert, a stone not exceeding three-quarters of an inch in its largest diameter—it may be safely removed by rapid dilatation with Hegar's dilators, followed by a finger (the little one first).

It is not meant by this that much larger stones have not been successfully passed and removed from the female bladder. Thus, Dr. Yelloly (*Med.-Chir. Trans.*, vol. vi. p. 574) gives a case in which a stone, weighing 3 oz. 3½ drs., was extracted: incontinence followed. Where large calculi—*e.g.*, of 6 oz.—have come away spontaneously, it has been usually by a process of prolapsus and ulceration combined. We do not yet know what is the greatest dilatation which the female urethra will safely bear. Perhaps the limit given above is, if anything, too small. Erichsen (*Surgery*, vol. ii. p. 1024) gives "8 or 10 lines in diameter" as the size of a stone which can be safely extracted by this means. Sir H. Thompson (*Syst. of Surg.*, vol. iii. p. 308) says, "dilatation should never be employed for any calculus larger than a small nut or a large bean in an adult, which limits its application to very few cases." Mr. Bryant (*Surgery*, vol. ii. p. 120) states that, "in children, a stone three-quarters of an inch in diameter, and in adults one inch, may be fearlessly removed from the bladder by rapid dilatation and extraction, with the patient under the influence of chloroform. I have removed larger calculi, two inches in diameter, by this means. without any injurious after-effect, but it is probably not wise to make the attempt, the surgeon possessing in lithotrity an efficient aid or substitute." Dr. Keyes (*Intern. Encycl. of Surg.*, vol. vi. p. 297) recommends not dilating the urethra more than three-quarters of an inch.

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* Mr. Bryant, in writing of the successes which lateral lithotomy has given in children (*Surgery*, vol. ii. p. 106) states that during seventeen years 100 patients had been cut consecutively at Guy's without a death. Another matter deserves mention. Cutting for stone is no longer limited, as of old, to a few great centres. How many institutions in or out of London, how many cottage hospitals, will be provided with the set of special instruments which are necessary?

2. **Litholapaxy.**—By this means calculus in the female bladder may be most frequently and efficiently treated. Thus, hard stones under an ounce, and phosphatic ones of a much larger size, may be dealt with at one sitting. The character of the ring or sound with the staff, the bite of the lithotrite, and the condition of the urine will aid here. A shorter instrument will be found much more convenient to work with. Where there is much irritability of the bladder, much difficulty will be met with in keeping fluid in it, owing to the absence of a prostate and the shortness and directness of the urethra. The pelvis must be well elevated, the patient placed fully under the anæsthetic, and the finger of an assistant should make pressure on the urethra. In other respects the operation resembles that already fully given for the male (p. 413). The dilatable urethra admits a full-size evacuating tube.

3. **Lithotomy.**—This operation is called for when the stones are multiple,* when one is large, especially if mainly hard as well, when there is a foreign body as a nucleus,† when there is great irritability with ulceration of the bladder, or when a growth co-exists.

Of the following methods—(*a*) vaginal, (*b*) supra-pubic, (*c*) urethral, and (*d*) the lateral method of Buchanan—the first two only need be alluded to.

Vaginal Lithotomy.—By this is meant extraction of a stone through an incision in the anterior vaginal wall, behind the vesical orifice of the urethra, and thus not interfering with this canal at all.

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* As in Dr. Galabin's case (*Obst. Soc. Trans.*, April 7, 1880), in which twelve large calculi and about fifty smaller ones were removed successfully by vaginal lithotomy from the bladder of a woman aged 61.

† As in the large stone formed round a hair-pin, and figured (p. 579) by Hart and Barbour in their *Manual of Gynæcology*. Here the projection of the hair-pin on either side of the stone would indicate, nowadays, the supra-pubic operation. I have alluded to a similar case in my practice at p. 406. Some of my readers may remember that a few years ago an inquest was held in London on the body of a girl who died with an undetected calculus in the bladder, which dated to a hair-pin. The sarcastic remarks of the coroner led to some correspondence in the papers, from which it would appear that these calculi are less rare than has been believed.

This anterior wall is about four inches long in the adult; in relation with it anteriorly is the urethra, to be felt as a cord through this wall, behind this the bladder, and farther back the os and cervix uteri. No peritonæum is normally in relation with this wall, as this membrane leaves the uterus half-way down to pass directly on to the bladder. No important vessels or nerves are met with in vaginal lithotomy; but this, though the simplest and easiest of all the methods of cutting for stone, will be but rarely called for, as in all moderate stones in women, litholapaxy is usually available, while in the case of larger ones, and with all calculi in female children, the supra-pubic method is indicated, save for tiny stones which can be removed after dilatation. The only drawback of a vaginal lithotomy in women is the risk of a fistula, but this need only be taken into account where phosphatic urine is present, or where the edges of the wound have been bruised during the extraction of the stone. In either case the calculus will probably be a large one or multiple, a condition, as already stated, which is better dealt with otherwise. The following case, which came under my care in 1889, is a good instance of how the operation may be occasionally called for:

"Vaginal Lithotomy in a Patient Six Months and a Half Pregnant; Immediate Suture of the Wound—Recovery; Normal Delivery at Full Time" (*Lancet*, vol. i. 1889, p. 628). A. L., aged 27, was sent to me by Dr. Montagu Day, of Harlow, December 7, 1888. For three years she had had bladder trouble—viz., hypogastric pain, cystitis, very frequent micturition day and night, with stoppages of the stream, and acute suffering after the bladder was emptied. The patient was extremely timid and nervous, owing to her four confinements having been "tight" and lingering. Craniotomy had been required with the first, and, with another, labour was induced at seven months.—December 8. The urethra was dilated, and the bladder explored. A calculus, apparently an inch in either diameter, was felt; the bladder was extremely contracted with its mucous membrane in places raw and bleeding, in others encrusted with phosphates. It was decided, for the reasons given below (426), to perform vaginal lithotomy.—December 10. Twenty-four hours after the exploration the patient had recovered control over her bladder. The vagina was thoroughly syringed out with hydr. perch. (1 to 1000), the posterior wall was well drawn down with a duckbill speculum. A straight lithotomy staff (No. 4) was then passed, and the site of the stone determined. A sharp hook was next inserted into the posterior part of the urethra so as to drag the anterior wall of the vagina upwards and forwards. This, however, caused such free oozing that it had to be removed, and sponge-pressure applied. The bleeding was partly caused by the vascularity of the parts due to pregnancy, and partly by that set up by the dilatation of the urethra two days before. A sharp-pointed bistoury, introduced so as to avoid the urethra and neck of the bladder, was carried into the groove of the staff through the anterior wall of the vagina and fundus of the bladder, and then backwards for nearly two inches. The gush of urine which at once followed on the withdrawal of the knife carried the stone downwards, and it was extracted with lithotomy forceps with the utmost ease. After the bladder had been explored with the finger, it was repeatedly washed out from the wound* with diluted Thompson's fluid. Little bleeding had followed on the incision, and it was clear that sutures would entirely control what remained. The vagina having been well sponged out, the edges of the incision, clean cut and without bruising,† were adjusted with six salmon-gut sutures and four of horse-hair. The apposition was tested with a fine probe, especially behind, where a little difficulty was met with in inserting the sutures. Owing to the patient's straining at this time, some urine escaped from the urethra, but none came through the wound. The vagina was next thoroughly syringed with a solution of hydr. perch. (1 in 3000), dried out with aseptic sponges, and dusted with iodoform. To secure more certain asepsis, and also to support the wound and sutures, the vagina was lightly plugged with strips of iodoform gauze. Though this was done with all gentleness, it was soon after noticed that blood was trickling from the vagina. On removal of the strips, two small lacerations on the right side of the vagina, near the orifice, the parts here being exceedingly pulpy and vascular, were oozing freely. This was arrested by tying up the bleeding points with chromic gut. The vagina was again irrigated and insufflated, but no further trial of plugging was made. As soon as the patient was replaced in bed, a soft catheter was inserted to empty into a "slipper." The recovery was rapid and without drawbacks. The ten sutures were removed on the eighth day with the aid of chloroform. The catheter was retained till the twelfth day, when the patient was allowed to get on a sofa. She left the hospital seventeen days after the operation. Dr. Day wrote, on March 19, that the patient had been safely confined without any trouble with the lithotomy incision.

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* It would be wiser to do this from the urethra.

† Under less favourable conditions closing the wound may have to be deferred till he parts are quite healthy.

The first question to decide here was whether to operate at once or to let the pregnancy (already advanced to six months and a half) be first concluded. While the stone itself was not large enough to have interfered with labour, both Dr. Day and I thought that, if the bladder were allowed to remain in its present state for another two months and a half, the cystitis would be rendered much more difficult of treatment, intensified, as it was likely to be, by a lingering and difficult confinement, such as the patient was liable to. It having been decided that it was advisable to interfere at once, the choice lay between (1) *dilatation of the urethra*, (2) *litholapaxy, and* (3) *lithotomy*. (1) *Dilatation.*—The size of the stone at once put this aside. Though small (240 gr.), it was a full inch in one diameter, and just over three-quarters of an inch in the other. With such a stone (a hard one, of lithic acid and lithates), there was a very serious risk of after-incontinence (especially when the blades of a small forceps have to be taken into consideration as well). (2) *Litholapaxy.*—If it had not been for the co-existing pregnancy, the stone might well have been thus dealt with. But as great irritability of the bladder was present, in addition to the pregnancy, it was thought that litholapaxy was more likely to require a prolonged anæsthetic and to cause greater disturbance of some important pelvic and abdominal viscera than the remarkably simple and rapid vaginal lithotomy. It will be remembered that the way in which the anæsthetic would be taken, and its after-results, were more than ever matters of uncertainty in this case. If the anæsthetic had been badly taken, we had to face the risks, on the one hand, of premature labour coming on, and, on the other, of difficulty in completing the operation, and thus of fragments being left behind, which would intensify the already existing cystitis. (3) *Lithotomy.*—It being decided to resort to this, the vaginal method was chosen from its great simplicity, the small amount of anæsthetic required, and the facilities which it gave for washing out the bladder at the time of the operation.

Supra-pubic Lithotomy.—This has been fully described at p. 400. The fluid is retained in the bladder by finger-pressure upon the orifice of the urethra.

B. *In Children.*—Some of the conclusions which Mr. Walsham has drawn in a very helpful paper (*St. Barthol. Hosp. Reports*, vol. xi. p. 129) may be quoted here:

For small stones rapid dilatation under chloroform is better, as causing less annoyance and inconvenience to the patient. That moderate- and even large-sized stones have been removed by dilatation, but that, as incontinence has frequently followed from over-distension, it is not justifiable to subject the patient to this risk. That, after limited dilatation, should the stone appear larger than was anticipated, it may be crushed with safety; but, should crushing be considered unadvisable or impossible, it is better to perform vaginal lithotomy than subject the patient to any risk of incontinence by over-dilatation. That it is not safe to aid the dilatation by incising the urethral walls. That incision of the urethra alone, without dilatation, in whatever direction practised, is frequently attended with incontinence, and should therefore be abandoned. That moderate and even large stones can be easily removed from young children by vaginal lithotomy, aided, if necessary, by dilatation of the vagina, incision of the fourchette, and crushing of the stone by the wound made through the septum, without any risk of a permanent vesico-vaginal fistula so long as the edges of the incision are not bruised in the extraction.

Mr. Walsham considers each of the above and several other points separately, and supports them with evidence. I think that this tends to show, in the case of vaginal lithotomy, that, though a stone may be thus extracted after dilatation of the vagina, division of the fourchette, and destruction of the hymen, it is by no means easy in these cases to insert sutures satisfactorily. It will be wiser, I think, to make use of the supra-pubic operation in female children for all save the very smallest stones. Litholapaxy, although by no means easy in these small bladders, is, however, held by Mr. Keegan (*Ind. Med. Rec.*, Aug. 1, 1897) to be the correct treatment in the great majority of cases of vesical calculus in women and girls.

I would refer my readers to a case of supra-pubic operation by Mr. Barwell in a child, aged 9, from whom a stone weighing two and a quarter ounces was successfully removed. It is interesting to note that Mr. Barwell was led to adopt the supra-pubic operation from his having had within seven months no less than three cases of vesico-vaginal fistulæ originating in the extraction of calculi during infancy and youth by different surgeons (*Med.-Chir. Trans.*, vol. lxix. p. 342).

CYSTOTOMY.

Indications.—The operation of opening the bladder, apart from such cases as exploring for growth, foreign body, &c., may be required in:

1. Some cases of cystitis. When the urine is fœtid and slimy. When pain in the bladder and penis is intense, leading to loss of sleep and appetite. When there is a high temperature and other evidence of imminent septicæmia. When all other treatment has failed, and when washing out is insufficient or unendurable.

The operation here, for the sake of the kidneys, must not be put off too late. Much benefit may be obtained by irrigating the bladder freely, and afterwards mopping it out with a small sponge and a solution of silver nitrate, ʒss or ʒj—℥j.

2. Some cases of great irritability of the bladder persisting after dilatation of a stricture. Mr. R. Harrison (*Surg. Dis. of the Urin. Org.*, p. 201) believes that the continuance of the irritability in these cases is due to the muscular hypertrophy which the bladder has undergone in its constant endeavours to force urine through the obstruction in front of it, and that the cystotomy is curative by bringing about atrophy or loss of that muscularity.

3. Some cases of tubercular cystitis (p. 385).

4. As part of other operations. Thus, in plastic operations about the urethra, to keep the parts dry, the bladder may be opened. I have done this in a case of epispadias.

5. As this operation will not again be alluded to, I may remind my readers that cystotomy, or, rather, opening the prostatic urethra on a staff, has been recommended by Sir H. Thompson (*Dis. of the Prostate*, p. 176) in those few but most distressing cases of enlarged prostate leading to hourly catheterism, cystitis, loss of sleep, and other aggravated symptoms.

6. Supra-pubic cystotomy is employed occasionally in Hunter's method of treating stricture by passing a sound from the bladder up to the perinæum.

Supra-pubic cystotomy for drainage of the bladder. A helpful account of this method is given by Mr. Bond (*Lancet*, vol. ii. 1889, p. 260). The distended bladder having been incised above the pubes in the ordinary way, the urethral orifice is felt for with the forefinger, and a curved staff passed until it bulges in the perinæum just below the bulb. The patient being placed in lithotomy position, the point of the staff is cut down upon, pushed through, and a rubber tube attached to it. This tube, with one or two openings in it, is drawn through above the pubes. In a few days it may be drawn into the bladder from below, and a little later withdrawn altogether.

Where the supra-pubic and perinæal incisions have been made use of for a stricture which cannot be dilated from the front, the curved sound is removed as soon as the perinæum has been opened, and the stricture thoroughly divided. A grooved director is then passed from the perinæum into the bladder, and upon this, as a guide, a full-sized catheter is passed from the urethra into the bladder and tied in. See a case of traumatic stricture thus treated by Mr. Howse (*Clin. Soc. Trans.*, vol. xii. p. 9).

The above are instances of cases calling for cystotomy. The surgeon will have to choose between three operations—viz., median and supra-pubic cystotomy and external urethrotomy. The median operation is almost always to be preferred to the lateral, but it is probable that external urethrotomy (p. 437) will be sufficient in most cases as to drainage, and it is certain that this operation is less risky from shock, cellulitis, and secondary hæmorrhage. The great object is to drain the cavity thoroughly.

RUPTURED BLADDER.

treatment of this hitherto most fatal injury has of late years
leared up.[*] Exploratory operations and suture of the bladder
increasingly successful in favourable cases—*i.e.*, those seen
nd those in which the injury is limited to the bladder.
forms of rupture are recognised—the intra- and extra-peritonæal.
be well to state, succinctly, the symptoms.
-peritonæal Rupture.—(1) History of a likely injury. (2) In-
to pass water.[†] This power has, however, been preserved in
arieties: naturally it is seen most frequently and more com-
in extra-peritonæal cases. It is very rarely normal in
tra-peritonæal ruptures. (3) A little bloody urine drawn
h a catheter. (4) Difficulty of manipulating an instru-
n a contracted bladder. (5) If the catheter, hitting off the
e passed beyond the bladder, a much larger quantity of blood-
fluid is withdrawn, partly urine, partly serum, from irritation of
ritonæum. If the flow through the catheter is markedly
ed by inspiration and diminished by expiration, the rent is
ly a large one. (6) Speedy (usually) supervention of peritonitis.
rhaps fluctuation and shifting dulness in the flanks.
a-peritonæal Rupture.—(1) History of a likely injury. (2)
ty to pass water (*vide supra*). (3) A little bloody urine drawn
4) The catheter finds the bladder contracted. (5) No tapping of
er amount of fluid. (6) Evidence of extravasation rather than
tonitis. Thus, if the rent is in front, the urine may be localised
with circumscribed dulness; or widely diffused, mounting up
s the umbilicus, between the abdominal muscles and the
æum; or passing into the iliac fossæ, or, by the canals, into the
n and thighs.
ust be remembered that the following may mislead: There may
little pain complained of; no sickness; a normal temperature;
tient may be able to walk; upwards of half a pint of urine may
wn off night and morning, and yet the peritonæal sac may contain
luid. Peritonitis may be absent post-mortem, though tympanites
ent during life, and though fluid be found in the peritonæal sac.
tient may live as long as five days, apparently improving, and
ie suddenly.
following may be useful in doubtful cases:
Walsham in his second case (*Trans. Med.-Chir. Soc.*, vol. lxxviii.
), to make certain of the existence of a rupture, made use of the
on of air, the injection of fluid not being conclusive. "For this
e the india-rubber apparatus belonging to an ether-freezing
ome was utilised, the tube of which was attached to the free end

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[*] ecially by Sir W. Mac Cormac's paper, with two successful cases, *Lancet*, 1886,
. 118. Many others have followed. Mr. Walsham has been able to report two
ul cases (*Trans. Med.-Chir. Soc.*, 1886 and 1895).

[†] s the rent may be valvular or blocked by intestine, &c. On all these and many
oints the reader should refer to Mr. Rivington's writings, *Dict. of Surg.*, vol. i.
nd *Rupture of the Urinary Bladder*, for exhaustive completeness and helpful
tion.

of the catheter. The liver dulness having been carefully percussed out, a few cubic inches of air were forced through the catheter by two or three contractions of the rubber ball. The effect was instantaneous. The abdominal cavity became distended, the liver dulness immediately effaced, and the whole abdomen tympanitic to percussion. The patient fell into a condition closely resembling collapse; he complained of great pain, his respiration was laboured, and the action of the heart turbulent."

This method was recommended by two American surgeons, Dr. Morton and Professor Keen, independently, in 1890. Mr. Walsham was the first to employ it.

Operation.—The patient being under an anæsthetic, the abdominal wall cleansed and shaved, and the parts relaxed,* a free incision five or six inches long in the adult, is made in the middle line. The linea alba having been divided, the recti retracted and partly detached if needful, all bleeding points secured, the lower angle of the wound and the parts behind the pubes are carefully examined for ecchymosis, extravasation, &c. If neither of these nor any collection of fluid is found outside the peritonæum, this is opened, when a large gush of fluid may be decisive. The surgeon now introduces one finger to feel for the rent, and the detection of this may be facilitated by passing a short-beaked sound. The rent will vary in site and length,† and also as to regularity, thickening, &c. If it be a long one, and reach downwards towards the recto-vesical cul-de-sac the introduction of a rectal bag (Fig. 163, p. 400), may be of assistance. Sir W. Mac Cormac also found that the bladder came up more readily after the parietal peritonæum had been transversely divided on each side. An assistant with carefully cleansed hands may render service at this time by hooking up the bladder with two fingers, while the intestines are kept back with sponges. The rent being now in view, is cleansed, and sutures of fine carbolised silk inserted. The shortest possible needle should be employed here, owing to the depth of the wound and the limited space there is to work in. Mr. Walsham in his second case found that a T. Smith's rectangular palate-needle answered admirably in inserting the deepest sutures. All of these should be put in before any are tied, and if the first are gently drawn upon it will facilitate the insertion of the others.‡ Sir W. Mac Cormac used sixteen sutures in one case and twelve in another, and his success is largely due to the great care with which they were inserted. Thus, they were put in a quarter of an inch apart, after Lembert's method (Fig. 55, p. 228), including the serous and muscular coats only, beginning at the lower part, the first and last sutures being inserted well beyond the limits of the injury so as to prevent leakage from the extremities. The following precautions are taken in passing them: Fine curved needles are used in holders; the serous surfaces are carefully inverted. The insertion of a finger into the rent will facilitate the passage of the deepest sutures. The sutures are passed through the serous and muscular coats only. This avoids the risk of traversing the mucous membrane, which in animals has nearly always proved fatal, because—(1) on tightening the sutures, the mucous membrane falls between the edges of the wound and hinders union; (2) the urine may find a channel through the points of passage of a suture, and so into the cavity of the peritonæum; (3) the loop of suture within the bladder is a foreign body, and salts may be deposited on it.

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* In Mr. Willett's case (*St. Barthol. Hosp. Reports*, vol. xii. p. 209) much difficulty was met with from the rigidity of the abdominal walls, and the great distension of the intestines, which kept crowding out of the wound, and were most difficult to replace. Peritonitis had set in here, twenty-four hours having elapsed since the injury.

† In Sir W. Mac Cormac's cases the rents were four and two inches long.

‡ In this case the rent was in the posterior wall extending from the summit along the middle line to the base of the trigone.

Wherever a gap appears, another suture should be inserted. If there is time, a few of chromic gut may be inserted through the serous coat only,* but Sir W. Mac Cormac regards the double row as unnecessary; 8 or 10 oz. of boracic acid are then injected into the bladder, to see if it is water-tight; or a coloured fluid, such as Condy's lotion, may be used. A few more sutures may be required till this fact is absolutely certain. The peritonæal cavity is now most carefully wiped out with sponges on ovariotomy clamp-forceps, pushed well down into the pelvis and the flanks till they come out clean and dry on squeezing.

Where the surgeon is doubtful about the state of the peritonæal sac, or where irrigation has been used, a glass tube should be left in the pelvic pouch and sucked out. A catheter should be passed at regular intervals.

Cases occasionally occur where the neck and not the body of the bladder is lacerated, a fracture of the pelvis perhaps co-existing. Where there is inability to pass water and where it is uncertain whether a catheter enters the bladder, it will be best to explore the front and neck of the bladder by a supra-pubic incision not opening the peritonæum. If blood-stained fluid well up, and if the catheter be detached lying outside the bladder, the bladder should be opened and a curved staff passed through the urethra and cut down upon in the perinæum. A drainage-tube should then be passed according to the directions given at p. 428.

This will drain the bladder effectually, and prevent any further escape of urine. The space outside the bladder, around its neck, must be cleaned thoroughly by the supra-pubic incision, tamponnaded with iodoform gauze, and, if needful, drained from the perinæum.

PUNCTURE OF THE BLADDER.

The following **methods** will be considered here:

i. **The Aspirator.**
ii. **Supra-pubic Puncture.**
iii. **Puncture per Rectum.**
iv. **Puncture through the Prostate.**

i. **The Aspirator.**—This may be used in cases of great urgency, when the surgeon is compelled to relieve retention without regard to the cause; when he is without the means of carrying out other and perhaps better methods; it is especially suited to those cases in which there is reason to believe that urine will again, in a few hours, be passed by the urethra. Thus, in gonorrhœal retention where a catheter cannot be passed, having perhaps been clumsily used, and where relief is urgently required; where retention has supervened on a stricture of only two or three years' standing, this means may be used successfully, giving time for warm baths and opium to act. In an old stricture, in one of traumatic origin, or in a case of enlarged prostate, it can only be a temporary measure, and should only be used when other instruments are not available.

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* Sutures through the serous coat only invariably give way.

The question arises, *How far will aspiration bear repetition?* This is quite uncertain. On the one hand, in a case of prostatic retention not admitting a catheter, the patient being, throughout, in a most grave condition, Dr. Brown (*Brit. Med. Journ.*, May 23, 1874) used the aspirator fifteen times between January 2nd and 12th, "with immediate relief on every occasion, and without the smallest inconvenience or injury from the punctures." Mr. Hague (*Lancet*, 1885, vol. ii. p. 385), in a patient, aged 90, with prostatic retention of forty-eight hours' duration, aspirated, and continued to do so daily for nearly five weeks, as no catheter could be passed. Such numerous aspirations caused no ill effects.

On the other hand, in a case of mine of prostatic retention in which the aspirator had been used only three times, on the death of the patient from bronchitis on the fourth day, the third and last puncture was found to be leaking. Dr. Campbell (*Brit. Med. Journ.*, Feb. 21, 1886) records a case in which the bladder had been aspirated twice, and internal urethrotomy then performed: "progress was good for a day or two, when some inflammation appeared at one of the punctures, an abscess formed, peritonitis came on, and the man died." Where aspiration is to be used, the condition of the bladder walls and of the urine must be taken into account.*

If aspiration be made use of, a fine needle should be employed, and introduced just above the pubes while an assistant steadies the bladder by pressure on either side. The bladder must not be allowed to become much distended before the puncture is repeated, otherwise urine may be forced out.

ii. **Supra-pubic Puncture.**—This operation has the *advantages* of being easily performed, of giving permanent relief if desired, and of being safe.

The two *objections* brought against it are, that (1) it gives bad drainage, and (2) it is liable to extravasation.† Neither of these is borne out by facts. While the patient is in bed, good drainage can be provided by turning him on one side and attaching tubing to the cannula; when the patient is up (and a cannula so placed is no drawback to this), the power of micturition will probably have returned. In a few cases of enlarged prostate the patient will be compelled to pass his urine this way for the rest of his life, but as soon as the parts are consolidated around the cannula, or the catheter which has replaced the cannula, micturition, though tedious, will be effected satisfactorily.

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* Mr. Bennett read a case before the Medico-Chirurgical Society (*Lancet*, 1888, vol. i. p. 418) of extra-peritonæal rupture of the bladder after aspiration in a patient long the subject of stricture. The opinion of most surgeons present seemed to be that aspiration was dangerously liable to leakage, especially in unhealthy bladders.

† Mr. T. Smith (*St. Barthol. Hosp. Reports*, vol. xvii. p. 291) writes: "I have seen no such tendency to extravasation; occasionally there is some inconvenience from leakage: this may be met by leaving out the cannula for a few hours, which allows recontraction to take place.

I may allude to three cases out of many in which I have used this method—two of retention with stricture, one of prostatic retention. I consider it the best all-round method, and the one of widest application that we have. Its relief is immediate, safe, and simple withal. The two cases of stricture were men under 40, admitted with a history of catheterism, bleeding urethræ, and recent false passages. On the fifth and second day I was able to pass a No. 7 silver, and, in the third case, a coudée catheter. For some cases of older strictures, especially if with fistulæ and a damaged perinæum, a longer rest is required, and Mr. Cock's or Mr. Wheelhouse's operation is indicated.

Operation.—This is most simple. A median puncture having been made through the skin just above the shaved pubes, the trocar is inserted. I prefer a curved trocar and cannula, the latter carrying tape-holes, but a straight trocar and cannula may be used, through which an 8 or 9 gum-elastic catheter, or, better, a Jacques' catheter, is inserted; in four hours the cannula can be removed, and a large catheter, a 10 or 12, introduced.* To keep the cannula firm at first, I insert a silver suture in the puncture, cover this with iodoform and collodion, and pack some strips of dry gauze around. I generally give a little anæsthetic, but this is not needed. The skin puncture is alone painful.

iii. **Puncture per Rectum.**—This has the advantage of draining a bladder well, but there are such serious disadvantages connected with it that the supra-pubic operation is always to be preferred to it.

Thus (1) it is difficult and most unpleasant to the patient to retain the cannula during defæcation and passage of flatus—the retention of a cannula is liable to cause troublesome tenesmus and diarrhœa; (2) when the cannula slips out it is difficult to replace it; † (3) the patient is kept in bed; (4) this method is not applicable to cases of enlarged prostate. I am aware that Mr. Bryant (*Surgery*, vol. ii. p. 153) states that "an enlarged prostate is no real obstacle to its performance, for this, if necessary, may be perforated with impunity." I cannot at all agree with the above, in spite of Mr. Bryant's authority. Being one of those who look upon an enlarged prostate, especially when congested with retention, and surrounded by an enlarged venous plexus, as a structure to be treated with great respect, I think that there is an undoubted risk that perforating it may lead to septic phlebitis and abscess, and to suppuration in already impaired kidneys.

Mr. Bryant (*loc. supra cit.*) speaks very highly of puncture per rectum, and says that the objections raised against it are theoretical only—viz., abscess between the bladder and rectum, persistent fistulous opening, injury to the vesiculæ seminales or the peritonæum. I do not deny that these injuries are rare, but, as compared with supra-pubic puncture, the drawbacks which I have given above are practical and undoubted.

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* If an aspirator has been used, and it is desired to replace it with a catheter, a catgut bougie should be passed through the cannula, and, this being withdrawn, a small gum-elastic catheter, with an eye in its point, is passed over the bougie. Larger ones can soon be got in, passing them with terminal eyes over the smaller ones, or by means of a stylet (T. Smith).

† Thus, there are two specimens in Guy's Hospital Museum proving, by the double puncture present, that this is the case.

Operation.—If this method is employed, Mr. Cock's instruments should be made use of—viz., a very sharp and a blunt pilot-trocar, and a cannula with inner tubes to keep the cannula in position and to admit of its being closed. The patient being in lithotomy position and the rectum emptied, the surgeon feels for the distended bladder, behind the prostate, with his left index finger. This being kept *in situ*, he introduces the cannula and blunt pilot along the finger up to the point he intends to puncture. The pilot being withdrawn, the sharp trocar is introduced, and when it is nearly up to the hilt in the cannula, it is depressed and then driven on in a direction upwards and forwards, as if aiming for the umbilicus. The trocar is then withdrawn, the inner tubes inserted, and the whole secured with tapes. The urine is best conveyed away by tubing.

iv. **Puncture through the Prostate.**—Mr. R. Harrison* has advocated this method, and published a most successful case in a patient, aged 84, with prostatic retention. A special straight trocar was introduced in the middle line three-quarters of an inch in front of the anus, and pushed steadily through the prostate into the bladder, the left index being retained in the rectum. The cannula was removed in nearly three months, natural micturition gradually returning. Atrophy of the enlarged prostate appeared to follow, and the symptoms were much relieved.

I cannot but think that this method runs the risk of septic phlebitis (*vide supra*). Another objection is that the patient is kept in bed. Micturition becomes natural much more quickly after supra-pubic puncture.

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* *Intern. Encycl. of Surg.*, vol. vi. p. 414.

CHAPTER XII.

OPERATIONS ON THE URETHRA AND PENIS.

RUPTURED URETHRA.—EXTERNAL URETHROTOMY.—INTERNAL URETHROTOMY. — CHOICE OF OPERATION FOR RELIEF OF RETENTION. — CIRCUMCISION. — AMPUTATION OF PENIS. — EPISPADIAS. —HYPOSPADIAS.

RUPTURED URETHRA.

In a few cases the surgeon may succeed in passing a catheter into the bladder. If he does so in a case where there has been much bruising* of the perinæum and extravasation of blood, a median incision should still be made to allow of relief of tension and escape of breaking down clots, and so give good drainage. If this is not done, the probability is great that a little later, owing to damage of soft parts, tension of blood clot, and a little escape of urine by the side of the catheter, this step will be required at a time when, from the presence of septic fever, and the condition of the extravasated blood and urine, the occasion is less favourable. Again, though a catheter can be passed at the time, it by no means follows that when, owing to its being plugged, or from some other reason, it requires removal in a few days, a fresh one can be inserted. An incision will then have to be made, and, as already stated, under conditions less favourable.†

When, as is usually the case, a catheter cannot be passed into the bladder, the patient is placed in lithotomy position, and the parts having been shaved and cleansed, a grooved staff of as full size as the parts will admit is passed as far as it will go—*i.e.*, to the site of the rupture; it is then made to project in the perinæum, and the surgeon, entering a straight sharp-pointed bistoury in the middle line at a point an inch to an inch and a half in front of the anus, pushes it on till it strikes the groove. and then cuts along this, both upwards and downwards, so as to expose freely the spot at which the urethra is ruptured. As the knife is brought out, the skin wound is enlarged till this is about an inch and a half long, the lower end being half an inch in front of the anus.

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* Complete rupture of the urethra may co-exist with a mere contusion of the perinæum, especially if much tenderness is present.

† Mr. Rutherford (*Glasgow Hosp. Rep.*) advises supra-pubic puncture in addition to any other procedure, and describes three cases in which he adopted this plan with advantage.

With the finger clots are now turned out, and, retractors being inserted deeply, the wound is sponged out thoroughly. A good deal of bleeding may now take place from some wounded vessel, hitherto closed by extravasated blood, or from the crus penis, detached on one side by the violence which ruptured the urethra, especially if there be a fractured pelvis. This hæmorrhage will yield to firm pressure or to forci-pressure. The anterior end of the urethra is next readily found by the end of the staff, which projects through it. The finding of the deeper or vesical end, often difficult, will be facilitated by careful sponging, a mirror and reflected light, pressure above the pubes, and the use of fine probes or straight gum-elastic catheters. This end often projects as a small clot or bleeding-point; at other times it resembles a partly twisted artery.*

If it be found, a catheter of as large size as possible should always be introduced, if practicable, from the meatus, and then through the vesical end of the urethra into the bladder, guided by a finger in the wound, a Brodie's probe, or a Teale's gorget (Fig. 174). If this be found impracticable, a catheter should be passed into the bladder from the wound. One of these methods should always be made use of, if possible, as it enables the patient to be kept dry by tubing attached to the catheter.

But if no catheter can be got into the bladder, either along the penis or from the wound, the surgeon need not worry himself as long as a free exit has been given for the urine and extravasated blood. In these cases it is not unusual for the bladder to become somewhat distended during the first two or three days, owing to the urine not escaping with sufficient freedom, or to the closure of the vesical end of the urethra from swelling after the injury and the manipulations to find it, or from the patient, if a child, shrinking from passing his water. This difficulty will usually be met by hot flannels frequently applied to the abdomen, and a few doses of laudanum, but if it be evident that the urine does not escape with sufficient freedom, the surgeon must again examine the wound with the aid of an anæsthetic, clean out any fresh clots, and again try to find the vesical end of the urethra, aided now, perhaps, by a better light.

If this fail, supra-pubic tapping or aspiration, or if the patient's condition be good, making a small supra-pubic opening into the bladder and thence passing a short curved staff into the perinæum and so finding the vesical end of the urethra (p. 428), must be resorted to.

Urethritis and cystitis are not uncommon in children. They are best met by, as soon as possible, leaving out the catheter for a while.

With regard to the question of trying to suture the urethra, it is always advisable, if possible, to draw the ends of the urethra together on the catheter, with a fine curved needle on a holder, and chromic gut or carbolised silk. But this will often be found a matter of great difficulty, and even impossible. When effected, it does not diminish the need of subsequent regular use of catheters.

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* The farther back the tear, the greater, of course, the difficulty in finding the urethra.

EXTERNAL URETHROTOMY (Figs. 172 to 176).

This operation includes the different forms of perinæal section with or without a guide—viz., Syme's, Wheelhouse's, and Cock's operation.

By some, **external urethrotomy** is reserved for those cases such as Syme's, in which a staff can be passed through the stricture, and "**perinæal section**" for those in which no such help is available—*e.g.*, Mr. Cock's operation. As, however, these terms are readily confused by students, and, as in Wheelhouse's operation a staff is used, though it cannot be passed through the stricture, I think it preferable to employ the term external urethrotomy, specifying which operation is meant by using the author's name—viz., Syme's external urethrotomy, &c.

Syme's External Urethrotomy.—Here the stricture is divided on a fine staff (*vide infra*) passed through it.

Indications.—This excellent operation is strongly indicated in (1) cases of stricture which do "not yield to dilatation, or, rather, continue to present symptoms after being dilated"—in other words, to contractile, irritable, and resilient strictures, in which dilatation is accompanied with much pain, or in which it is found that a No. 7 can perhaps be passed one day and only a No. 3 a day or two after; (2) cases in which rigors and constitutional disturbance follow any attempt at dilatation.

Operation.—The patient, having been prepared by mild aperients and bland liquid diet for the operation, is brought under an anæsthetic, and while his legs hang over the end of the table, the surgeon introduces a Syme's staff. This has a narrow terminal portion, which passes through the stricture, a shoulder which rests upon the face of the stricture, and a wider, stouter part above the shoulder to make the instrument easier to find in the perinæum. The patient being placed, in a good light, in lithotomy position, and the parts cleansed and shaved, the surgeon makes an incision exactly in the median line down upon the staff, exposing the wider portion above the shoulder. When the surgeon is certain that this is laid bare, he runs the knife forwards along the groove, so as to divide the stricture completely. The staff is now withdrawn, and the rest of the treatment must vary somewhat. If the condition of the patient admits of it, a full-sized gum-elastic catheter should be passed from the meatus into the bladder, guided by a finger in the wound or in the rectum, or by a grooved director passed from the perinæum. If the irritability of the parts does not admit of this, a gum-elastic catheter must be inserted from the perinæum, cut short, and kept *in situ* with tapes, the urine running off, by tubing attached, into a basin containing carbolic acid lotion; or Prof. Syme's curved perinæal catheter may be employed.

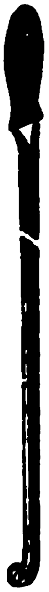
As soon as a catheter can be passed from the meatus, it should be kept in for two or three days, and changed, if needful, with an anæsthetic at first. As soon as possible, it should be passed twice a day, and the patient should be clearly told of the absolute necessity which exists of keeping up the good effects of the operation by the passage of an instrument at regular intervals, and of occasionally reporting himself to his surgeon.

Wheelhouse's External Urethrotomy.—Here the stricture is first found by a staff passed down to it and then divided on a fine probe-pointed director passed through it.

Mr. Wheelhouse (*Brit. Med. Journ.*, June [illegible]) recommends his method as having "the advantage of greatly increased precision; it renders an operation, confessedly hitherto one of the most difficult in surgery, a comparatively easy one, and one which, in my hands and in those of my colleagues, has given results infinitely more favourable, with an immediate and ultimate effect upon our cases, than we had ever seen before its introduction."

Operation.—"The patient is placed in lithotomy position, with the pelvis a little elevated, so as to permit the light to fall well upon it, and into the wound to be made. The staff* (Fig. 172) is to be introduced with the groove looking toward the surface and brought gently into contact with the stricture. It should not be pressed much against the stricture, for fear of tearing the tissues of the urethra and causing it to leave the canal, which would mar the whole after-proceedings, which depend upon the urethra being opened *a quarter of an inch in front of the stricture.* Whilst an assistant holds the staff in this position, an incision is made into the perinæum, extending from opposite the point of reflection of the superficial fascia to the outer edge of the sphincter ani. The tissues of the perinæum are to be steadily divided until the urethra is reached. This is now to be opened, *in the groove* of the staff, *not upon its point*, so as certainly to secure a quarter of an inch of healthy tube immediately in front of the stricture. As soon as the urethra is opened, and the groove in the staff fully exposed, the edges of the healthy urethra are to be seized on each side with straight-bladed nibbed forceps and held apart. The staff is then to be gently withdrawn until the button-point appears in the wound. It is then to be turned round, so that the groove may look to the pubes and the button may be hooked on to the upper angle of the opened urethra, which is then held stretched open at three points thus (Fig. 173), and the operator looks into it immediately in front of the stricture. While thus held open, a probe-pointed director † is inserted into the urethra, and the operator, if he cannot see the opening of the stricture, which is often possible, generally succeeds in very quickly finding it, and passes the point onwards *through* the stricture towards the bladder. The stricture is sometimes hidden amongst a crop of granulations or warty growths, in the midst of which the probe-point easily finds the true passage. The director having been passed into the bladder (its entrance into which is clearly demonstrated by the freedom of its movements), its groove is turned downwards, the whole length of the stricture is carefully and

FIG. 172.



(Wheelhouse.)

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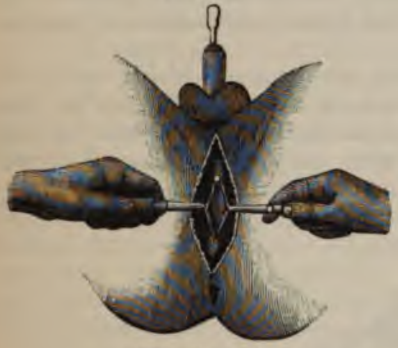
* This is fully grooved through the greater part, but not through the whole of its extent, the last half inch of the groove being "stopped" and terminating in a round button-like end.

† Or a common blunt-pointed probe may be used. Occasionally a bougie (No. 2 or 3) is useful.

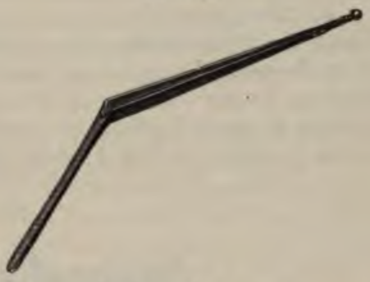
deliberately divided on its under surface, and the passage is thus cleared. The director is still held in the same position, and a straight probe-pointed bistoury is run along the groove to ensure complete division of all bands or other obstructions. These having been thoroughly cleared, the old difficulty of directing the point of a catheter through the divided stricture and onwards into the bladder is to be overcome. To effect this, the point of a probe-gorget (Fig. 174) is introduced into the groove in the director, and, guided by it, is passed onwards into the bladder dilating the divided stricture, and forming a metallic floor, along which the point of the catheter cannot fail to pass securely into the bladder. The entry of the gorget into the latter viscus is signalised by an immediate gush of urine along it. A silver catheter (No. 10 or 11) is now passed from the meatus down into the wound, is made to pass once or twice through the divided urethra, where it can be seen in the wound, to render certain the fact that no obstructing bands have been left undivided, and is then, guided by the probe-gorget, passed easily and certainly along the posterior part of the urethra into the bladder (Fig. 175). The gorget is now withdrawn, the catheter fastened in the urethra and allowed to remain for three or four days, an elastic tube conveying the urine away. After three or four days the catheter is removed, and is then passed daily, or every second or third day, according to circumstances, until the wound in the perinæum is healed; and after the parts have become consolidated, it requires, of course, to be passed still, from time to time, to prevent recontraction."*

FIG. 173.



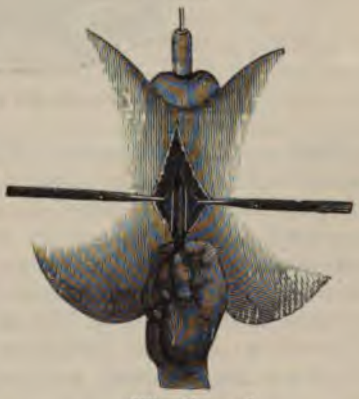
(Wheelhouse.)

FIG. 174.



Teale's probe-gorget.

FIG. 175.



(Wheelhouse.)

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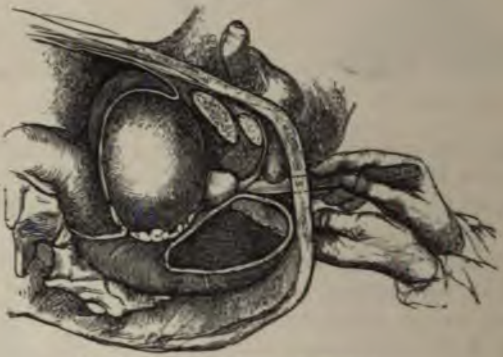
* The wound should be syringed occasionally during the operation with a dilute solution of mercury perchloride, and a little iodoform dusted in at the close. If any

This will be found a most effectual operation, but in many cases the hitting off of the mouth of the stricture is a less simple matter than would be gathered from Mr. Wheelhouse's account. This is especially the case when the parts are engorged and softened, as the free oozing which is met with under these conditions may be most difficult to arrest even with firmly applied sponges on holders, the slightest trickling of blood being sufficient to obscure the orifice of the stricture. A false passage at the site of the stricture may complicate matters very much, and a stricture in the penile portion of the urethra may prevent the passage of the staff altogether. A good light, gentleness and patience are at all times requisite.

Cock's Operation.—An external urethrotomy, which opens the urethra behind the stricture, and without a guide (Fig. 176). The following, in the words of its deviser, are the *advantages* of this operation so well known to Guy's men (*Guy's Hosp. Reports*, 1866, vol. xii. p. 267): "The bladder is reached without any unnecessary mutilation of the perinæum. The communication is effected in nearly a straight line from the exterior to the cavity of the viscus, so that the cannula, which is inserted and retained, can be removed whenever necessary, and can be easily replaced. The functions of the entire urethra are suspended, and may be kept in abeyance for an unlimited period. The urine no longer finds its way abnormally through the stricture and sinuses of the perinæum. The tissues are no longer subjected to constant irritation from infiltration. The constitutional symptoms are relieved, and time and opportunity are given for the removal by absorption of those adventitious products which obstructed the urethra, indurated the perinæum, and rendered the introduction of an instrument impossible. The pressure on the kidneys is removed, and, if expedient, the bladder may be readily washed out, until its lining membrane assumes a healthy character. The strictured and damaged portion of the urethra being no longer subjected to the constant pressure of urine from behind, may probably so far recover

FIG. 176.



Mr. Cock's operation. (Bryant.)

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bleeding is going on, the wound should be plugged around the catheter with strips of iodoform or sal-alembroth gauze, or Spencer Wells's forceps left *in situ*.

itself as to allow of restoration by the ordinary means of dilatation; or, should the canal have become permanently obliterated, the patient still retains the means of emptying his bladder through the artificial opening without difficulty or distress, and at very moderate inconvenience to himself."

The following are *the cases to which the operation is well suited:* Where the stricture has existed for a number of years; where the urethra has become permanently obstructed or destroyed by the constant pressure of urine from behind, and by reiterated attempts, generally fruitless, to introduce an instrument; where extravasation into the perinæum has again and again taken place, causing repeated abscesses and their consequences, the formation of urinary sinuses and fistulæ, until the normal textures of the perinæum become obliterated, and are replaced by an indurated, gristly structure; where the bladder has become thickened and contracted by the constant action of its muscular coat until little or no cavity is left, and where the urine is constantly distilling by drops, either through the urethra or through one or several fistulous openings, which dot the surface of the perinæum, penetrate through the indurated scrotum, and even find their way to the nates below, and the region of the pubes above. If unrelieved, these cases invariably terminate fatally.

The keystone of the whole proceeding is the fact that, "however complicated may be the derangement of the perinæum, and however extensive the obstruction of the urethra, one portion of the canal behind the stricture is always healthy, often dilated, and accessible to the knife of the surgeon. I mean that portion of the urethra which emerges from the apex of the prostate—a part which is never the subject of stricture, and whose exact anatomical position may be brought under the recognition of the finger of the operator."

Operation.—"The patient is to be placed in the usual position for lithotomy; and it is of the utmost importance that the body and pelvis should be straight, so that the median line may be accurately preserved. The left forefinger of the operator is then introduced into the rectum, the bearings of the prostate are next examined and ascertained, and the tip of the finger is lodged at the apex of the gland. The knife is then plunged steadily, but boldly, into the median line of the perinæum, and carried on in a direction towards the tip of the left forefinger, which lies in the rectum. At the same time, by an upward and downward movement, the vertical incision may be carried in the median line to any extent that is considered desirable. The lower extremity of the wound should come to within half an inch of the anus.

"The knife should never be withdrawn in its progress towards the apex of the prostate, but its onward course must be steadily maintained, until its point can be felt in close proximity to the tip of the left forefinger. When the operator has fully assured himself as to the relative position of his finger, the apex of the prostate, and the point of his knife, the latter is to be advanced with a section somewhat obliquely, either to the right or the left, and it can hardly fail to pierce the urethra. If, in this step of the operation, the anterior extremity of the prostate should be somewhat incised, it is a matter of no consequence.

"In this operation it is of the utmost importance that the knife be not removed from the wound, and that no deviation be made from its original direction until the object is accomplished. If the knife be prematurely removed, it will probably, when re-inserted, make a fresh incision and complicate the desired result. It will be seen that the wound, when completed, represents a triangle, the base being the external vertical incision through the perinæum, while the apex, and consequently the point of the knife, impinges on the prostate. This shape of the wound facilitates the next step of the operation.

"The knife is now withdrawn, but the left forefinger is still retained in the rectum. The probe-pointed director is carried through the wound, and, guided by the left forefinger, enters the urethra, and is passed into the bladder. A No. 12 gum-elastic catheter, straightened on its stylet, is slid along the director, the stylet then removed, the catheter cut short, and secured in position with tapes."

While most fully alive to the excellence of this operation, both as to speediness of relief and the perfect rest it gives to damaged parts, I should like to point out to those who are only likely to perform it occasionally, (*a*) that it is not such an easy operation as it appears; (*b*) that it is a severer operation than the size of the wound would suggest. Hæmorrhage is not very uncommon from the engorged condition of the parts, and a low form of septic phlebitis is not very infrequent after the operation. For these reasons I would restrict it to the cases mentioned at p. 441.

Complications and Causes of Failure after External Urethrotomy. 1. Hæmorrhage (footnote, p. 439). 2. Rigors. These should be met by warmth, leaving out the catheter or substituting a softer one; plenty of diluent drinks, washing out the bladder with diluted Thompson's fluid (p. 401), Dover's powders, or small injections of morphia, if the condition of the kidney admits of these. Five or ten grains of quinine may be given in milk every two or three hours, if it does not excite vomiting. 3. Septic troubles—*e.g.*, septic phlebitis. 4. Pelvic cellulitis. 5. Persistence of a fistulous opening in the perinæum. 6. Recurrence of the contraction.

CHOICE OF AN OPERATION FOR THE RELIEF OF STRICTURE-RETENTION.*

It will have been gathered from the remarks at p. 432 that **supra-pubic aspiration** † may be used in very urgent cases, and may be repeated safely once where this fails. In many cases where the patient is still comparatively young, where the stricture is not of long duration, where there are no urinary fistulæ or a damaged perinæum, the retention can be relieved and the cure of the stricture started by **forcible dilatation.** Ether or A.C.E. having been given, the surgeon takes a silver catheter with a short beak, No. 4, 5, or 6, and makes forcible steady pressure against the face of the stricture. The penis should be kept stretched by an assistant, so that the left fingers of the surgeon are free to keep note of the middle line. After a few minutes, perhaps aided by a smaller size of catheter, the point is felt to pass on, *in the middle line, without any jump, and without causing much bleeding.* The surgeon is thus sure that he has not made a false passage, and keeps touch of the passage of the catheter down the centre of the perinæum with his finger, which is next introduced into the rectum. Here the pulp of the finger keeps the tip of the catheter a little up, and notices carefully whether the instrument is in the middle line and whether it is separated from the finger by a due thickness of tissues. If these points are secured and the point of the catheter moves freely, the surgeon may be assured that he has reached the bladder. I have used this method of careful forcible dilatation repeatedly, and think most highly of it.

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* Supra-pubic tapping has been already recommended for retention due to an enlarged prostate.

† In the absence of an aspirator, an ordinary hydrocele trocar may be safely used.

Where this fails, for the large majority of cases of retention due to stricture, especially where the patient is under 45, and a few days' rest will ensure the passage of a catheter, I believe that **supra-pubic tapping of the bladder** will be the safest and simplest operation. This will be followed in four or five days by the passage of a catheter, aided by an anæsthetic, and guided by a little judicious force, combined with a knowledge of anatomy. **Wheelhouse's operation** is very highly spoken of by the Leeds surgeons. A good light and especial instruments are essential. The cases to which **Mr. Cock's** excellent **operation** should be limited have been already pointed out (p. 441).

INTERNAL URETHROTOMY.

Indications.—Before specifying these, I would say that, with regard to the question between external and internal urethrotomy, or the need of either, it is chiefly a matter of personal experience. In other words, surgeons who practise usually some such operation as that of Prof. Syme, and I confess I am of the number, when careful forcible dilatation aided by an anæsthetic fails, will probably have as good results as those who resort to internal urethrotomy. As it is a clean division of the entire stricture which is required, this can be effected most readily, and with less practice, and with simpler instruments, by external urethrotomy. But it must be remembered that, after all, it is not so much the division of the stricture, whether from without or within, which will be curative, as the amount of perseverance which the patient shows afterwards. Again, at the commencement of internal urethrotomy, each stricture must be dilated sufficiently to admit, in the case of an instrument cutting from without inwards, a split sound equivalent to No. 2 English, while in instruments cutting in the opposite direction, the bulb is as large as No. 4 or 5. This being so, the cases must be very few in which the surgeon does not find it possible, and in which the patient does not prefer, to complete the case by dilatation.

Amongst these few cases are—1. Strictures localised and of the nature of annular, which (a) contract rapidly after dilatation, or (β) in which rigors persistently follow attempts at dilatation. 2. Non-dilatable strictures—*e.g.*, some traumatic ones. 3. Penile strictures. These are very elastic and shrink quickly after dilatation, and incision of these strictures seldom causes serious constitutional disturbance. 4. In some cases where time is an object. Thus, in young subjects whose disease has not existed long enough to alter the condition of the kidneys, cutting may be admissible for a stricture that should be simply dilated in an older patient whose kidneys have undergone degeneration (Berkeley Hill, *Dict. of Surg.*, vol. ii. p. 727). 5. According to some (Berkeley Hill, *loc. supra cit.*), urethrotomy affords a longer interval of freedom from contraction than does any other plan of widening a stricture.

Contra-indications.

1. Strictures not localised and ring-like, but extending over a considerable surface. 2. A "stricture" in which the difficulty is mainly due to congestion,* though this is scarcely a stricture at all. 3. A stricture accompanied by urethritis.

I have endeavoured to point out fairly the indications for internal urethrotomy. I suspect that this is one of those operations of which an increasingly frequent use is liable to lead to something very like abuse. But, however this may be, I should like to point out first a fallacy as it seems to me. Thus, Sir H. Thompson (*Dis. of Urin. Organs*, p. 40) speaks of a urethrotome as "nothing more than a little knife with a long blade . . . . used precisely as we use a scalpel anywhere else. Just as we should use a small knife in tenotomy, without the sense of vision, where it is not necessary, but guided by the sense of touch, so do I advise you to act in urethrotomy." No doubt this comparison is correct as far as it goes, but its very simplicity is misleading. There can be no real comparison, I maintain, between division of a tendon, which can always be practically made subcutaneous, and that of a stricture, perhaps four inches from the surface, surrounded by vascular tissue, incision of which may easily lead to hæmorrhage or septic trouble, an incision which cannot from the subsequent flow of urine be completed aseptically, and which implicates other parts in such intimate sympathy with that operated on—*e.g.*, the kidneys.

Again, I would point out that internal urethrotomy is not the simple affair that it is sometimes represented to be. I would refer my readers to the experience of one whose name is associated with this operation. Mr. Berkeley Hill (*Lancet*, April 8, 1876, p. 524) speaks thus of a trial which he gave to the method of treating early stricture by Otis's operation of internal urethrotomy:

"All the cases operated on were those of long-standing gleets, with contraction in one or more parts of the spongy urethra, and had undergone multifarious treatment. The number of patients is sixteen—fifteen of my own, and one of Dr. Otis's. In five cases the gleet stopped after the operation, and the patient was at the last report—taken in none less than three weeks, in most some months, after the operation—able to pass a bougie of the estimated size of the urethra. In short, they may be claimed as cures. But of these five the operation was serious to two; one had free bleeding for three days, the other three attacks of rigors. Of the remaining eleven, among whom Dr. Otis's own operation must be included, the gleet persisted in all; in several the urethra shrank again to its size before the operation, and in some very serious complications ensued. In four, bleeding lasted several days and in one was alarming. Three patients had rigors; in two the shivering was unimportant, being that which follows the first transit of urine along the incised urethra in certain individuals, but is not repeated or attended by further consequences. In the third patient the rigors preceded abscess in the buttock. One patient had orchitis. Thus, in seven the operation might fairly be termed a trifle, causing no pain nor any after-fever, but in five only was the operation successful."

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* As bearing upon the allied condition of "spasm," the late Mr. B. Hill (*Brit. Med. Journ.*, 1870, vol. ii. p. 856) stated that if an apparently narrow bulbo-membranous and a penile stricture co-exist, on the latter being properly divided, the former will disappear, having been due to reflex muscular contraction.

Complications.—(1) Hæmorrhage. If severe this may be met by pressure on the perinæum, with a pad or a stick in the bed so that the patient may keep up the compression himself. (2) Perinæal abscess. (3) Sloughing and perinæal fistula. These are very rare. (4) Extravasation. (5) Septicæmia. (6) Epididymitis. The first five of these are usually due to cutting too deeply, or to the patient not being sufficiently prepared or unfit for the operation. The last is usually brought about by injudicious haste in the use of bougies.

The essentials of a good urethrotome are: (1) a guide through the stricture into the bladder, usually in the form of a filiform guide-bougie, or of a curved terminal portion of the urethrotome, sufficiently fine to pass through the narrowest stricture; (2) a cutting edge which, at first shielded, can be protruded by the surgeon as exactly as he desires; (3) some means of steadying the mobile stricture fibres as they are divided.

Two Chief Modes of Internal Urethrotomy.—The stricture may be divided—(*a*) **From without inwards**—*i.e.*, **towards the bladder.** (*b*) **From within outwards, away from the bladder.** A short account of the chief instruments will be given, and the two methods briefly contrasted.

a. **Those Cutting from Without Inwards.**—By this means narrower strictures can be divided than in the other method, in which the instruments used are generally based on Civiale's pattern, in which the bulbous end carries the knife.

Most of the urethrotomes which cut from without inwards are modifications of Maisonneuve's pattern. A fine hollow staff being guided through the stricture by a filiform bougie, along the hollow staff a stylet carrying a triangular shield or wedge is run; this pushed against the stricture serves to steady it, while it is divided by a knife concealed in the wedge or shield.

One of the best known of the recent instruments on this pattern is the late Mr. B. Hill's. It consists of a narrow split sound, No. 2 English, which can be guided through narrow tortuous strictures by being attached to a filiform bougie, previously passed into the bladder.* Secondly, a wedge runs along dovetail grooves between the halves of the split sound. In this wedge is concealed a knife that can be protruded between the halves of the split sound, when the stricture-tissue prevents their separation sufficiently to allow the wedge to pass on. The wedge,† pushed up to the situation of the stricture, in separating the split sound tightens and steadies the stricture thoroughly, while the knife divides it to the width required by the wedge to pass along.* If a wedge be chosen to expand the urethra to its full natural capacity, the cut will not pass beyond the stricture into the vascular erectile tissue external to it. The knife can be applied to the upper or under surface of the stricture as preferred.

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* If it is doubtful whether the guide has reached the bladder, Mr. Hill advised to screw on a No. ½ flexible catheter to the guide, and to push the whole onwards till the catheter has passed eight inches inwards. A small exhausting syringe is then applied to the catheter, and a few drops of urine drawn through it.

† The meatus must be divided, if too small to admit the wedge.

b. **Those Cutting from Within Outwards.**—A good representative of these instruments is Sir H. Thompson's modification of Civiale's urethrotome. This has a bulbous extremity, from which the blade is protruded. The stricture being sufficiently dilated to admit a No. 4 or 5 bougie, the bulb (which forms a useful sound) is carried about one-third of an inch beyond the stricture, the knife projected, and the incision made by drawing it slowly and firmly outwards—to the distance of half an inch to two inches—generally along the floor of the urethra, so as to incise the stricture freely. A metallic bougie is then passed, and if at any point it is held closely, there is still almost certainly some spot which needs touching with the blade.

After-treatment.—This varies very much. Some surgeons—*e.g.*, Sir H. Thompson and Mr. Harrison—pass at once and tie in a full-sized catheter for twenty-four or forty-eight hours, passing after this a full-sized instrument at intervals. Others—*e.g.*, Mr. B. Hill—draw off the urine with a full-sized catheter, after division of the stricture, but tie none in. The patient is ordered not to micturate for eight hours if possible. By this time the incision is protected by clot and plastic lymph, and when the bladder must be emptied, the patient passes water in a hot bath, pain, spasm, and risk of tearing open the wound being thus avoided. The patient is kept in bed for ten days, and about the eighth day a full-sized bougie is passed, this period of rest being insisted upon to avoid pain, bleeding, and suppuration.

Comparison of the two Methods of Internal Urethrotomy.—With the instruments which cut from without inwards, guided by a filiform bougie, narrower strictures can be attacked than by the bulbous-ended urethrotome, cutting in the reverse direction. These latter have been recommended as having the advantage of steadying the fibres to be cut by their pulling forwards the parts which attach the urethra to the pelvis as the bulbous end of the instrument is drawn out. The stricture is thus pulled on by the instrument until the divided stricture gives free passage to the bulbous shield and the knife protruded from it. Mr. B. Hill, however, considered that "reliance cannot be placed on the simple straining of these attachments ensuring perfect division of the stricture tissue. A Civiale's or any other urethrotome which cuts from within outwards is very apt to wriggle its way through a stricture, only scoring it, but not perfectly severing its fibres, and to meet this difficulty the knife is often carried more deeply than is necessary." Mr. Hill further believes that by cutting from without inwards there is less risk "of making an incision through a thin layer of fibrous tissue into erectile tissue, in the belief that a thick layer of fibrous tissue exists," and thus of causing free hæmorrhage.

While myself usually practising what, on the whole, I believe to be preferable, continuous dilatation aided, if need be, by external urethrotomy such as Prof. Syme's operation, I have, I trust, here fairly dealt with internal urethrotomy. Before leaving this matter I should like to allude to the question of *time*. Internal urethrotomy no doubt saves time and trouble also, but it must not be thought that the saving is a large one. Thus, with regard to time, Mr. B. Hill wrote: * "It is indispensable that the patient lie in bed continuously for at least ten days, and keep his room for fourteen days." Subsequent regular passage of a bougie is as needful after internal urethrotomy as any other mode of treating stricture.

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* After the first cut, the knife is withdrawn within the wedge, and only protruded when a tight band opposes the free passage of the wedge.

ECTOPIA VESICÆ AND EPISPADIAS.

The various plans that have been devised for the relief of this most miserable condition may practically be divided into two groups. The *first group* consists of plastic operations, which aim at the formation of a new anterior vesical wall and urethra. Those methods associated with the names of Wood and Maydl have been most widely adopted. As will be seen by reference to the description given below, the anterior wall of the bladder is formed by skin-flaps. The advantages gained by the operation, if successful, are that a receptacle for the urine is formed, and that the exposed mucous membrane is covered in. On the other hand, there is no sphincter, therefore no control, and a urinal must be worn constantly as before. Moreover, with the growth of hair into the bladder cystitis is set up and the hairs are constantly the seat of phosphatic deposit which will probably have to be removed at intervals.

Attempts have, however, been recently made to form the new bladder of mucous membrane instead of skin. Tizzoni and Poggi successfully removed the bladder of a dog and replaced it by a new bladder formed from a piece of small intestine, which they left attached to its mesentery after having cut it out of the circuit of the alimentary canal. Rutkowski (*Centr. für Chir.*, No. 16, 1899), acting on this suggestion, successfully made use of an intestinal flap for ectopia in a boy aged 9.

The following account of the operation is given by Warbasse (*Ann. of Surg.*, Aug., 1899):

> A median incision, six centimètres long, was made, terminating below at the bladder. After opening the abdomen, a coil of ileum was brought out and divided at two points, six centimètres apart. This six centimètres of intestine was isolated. The intestine was united by an end-to-end anastomosis with two rows of continuous silk suture, and replaced in the abdomen. The excised segment was divided longitudinally opposite its mesentery, thus forming a quadrilateral flap about forty square centimètres in size, attached to the mesentery along its middle. After detaching the bladder from the abdominal wall and enlarging the bladder opening, the intestinal flap was sutured by two rows of running suture into the defect. The deeper suture of catgut included the entire thickness of the bladder and intestinal walls, with the exception of the mucosa. The outer suture of silk was applied as a Lembert suture. This gave a urinary bladder with an anterior wall formed from intestinal flap receiving its nourishment through its own segment of mesentery. Over the whole the abdominal wall was closed. A

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* *Dict. of Surg.*, vol. ii. p. 729. See also the Lectures, alike candid and helpful in detail, by the same surgeon (*Brit. Med. Journ.* 1879, vol. ii. pp. 763 *et seq.*)

catheter was left in the urethra for permanent drainage of the bladder. The operation lasted an hour and a-half. The condition of the patient immediately after the operation was excellent. The post-operative course of the case was ideal, entirely afebrile. The wound healed per primane. On the tenth day the sutures were removed. Eight weeks after the operation the patient was able to retain twenty-five cubic centimètres of urine in the bladder. Under pressure this amount could be increased to thirty cubic centimètres."

In the *second group* of operations no attempt is made to form a bladder, but the course of the urine is diverted into the bowel, which thus becomes the receptacle for the urine.

A number of surgeons have excised the vesical mucous membrane and implanted the ureters in the rectum or sigmoid. The chief objection to this is the liability to infection of the ureters from the bowel, resulting in ascending nephritis. Maydl has, however, largely overcome the risk of infection by implanting the whole trigone into the rectum, thus retaining the valvular orifices of the ureters. Brandsford Lewis (*Ann. of Surg.*, June, 1900), in a review of this subject, quotes a number of cases operated on by Maydl's method. The following case, operated upon by Dr. Herezel, of Budapest, will serve to illustrate what may be hoped for as a result of this operation:

"A boy, 5 years old, was operated on in May, 1897. In March, 1898, his condition was reported by the operator as admirable. Quantity of urine 1000—1200 cubic centimètres in twenty-four hours; specific gravity 1013; slight amount of albumen, no pus. The boy was able to hold the urine five hours at a time, and then to eject it in a good stream from the rectum. In August, 1899 (a year and a-half after the operation) the condition continued as satisfactory. The patient, now a rapidly growing and strengthening boy, enjoyed living, retaining his urine for six or seven hours during the day-time, but relieving himself oftener at night, or running the risk of wetting the bed while in deep sleep."

The same author also quotes the results of seventeen operations by Maydl's method, collected by Nové-Josserand. There were two deaths—one from shock, and the other from infection. "The secondary accidents noted were fistulæ of the urinary passages with an accompanying localised peritonitis, all of which cases recovered. Pyelonephritis, as the result of ascending infection, resulted in the death of one case after a period of four months. Urinary continence was perfect in all the cases excepting two. The patients were able to hold their urine for at least three hours, sometimes six or seven hours, and in one case throughout the night. The urine was voided sometimes mixed with fæcal matter, sometimes alone. The tolerance of the rectal membrane was perfect."

In spite of the fact that this operation is undoubtedly far more severe than the plastic method, the immediate results are extremely good, and far better than those of the older methods. Time alone can settle the question as to whether destruction of the kidneys from ascending inflammation will be a more common late result than after a plastic operation.

Operations.—Two will be described: (1) Wood's plastic method: (2) Cysto-colostomy, or Maydl's operation.

(1) **Wood's Operation.**

Age.—The cure of the ectopia may be commenced after the child is four or five, and should be completed, if possible, by puberty. In this case the epispadias may be taken in hand and completed before adolescence, when the growth of hairs and sexual desires will interfere much with the union of the flaps.

Unfavourable Conditions.[*]—1. Large size of the ectopia, with much bleeding and some purulent discharge from the surface. 2. A sickly condition of the patient, pointing to poor powers of repair, and a waddling gait to wide separation of the pubes. 3. Tendency to cough. This increases the protrusion. 4. Presence of large herniæ. 5. Secondary dilatation of the ureters and pelves of the kidneys, with degeneration of viscera. Mr. Wood (*loc. supra cit.*) shows that sometimes the above complication may be recognised by the presence of more albuminuria than is accounted for by the amount of cystitis. In other cases no such signs are present. Out of forty cases, a fatal result, chiefly from this cause and undetected, followed in four. 6. Obstinate eczematous rawness. 7. Small size of the scrotum. This is rare.

Preparatory Treatment.—If the patient has passed puberty, and the hair is at all abundant, depilation should be practised, and nitric acid applied at intervals to the groups of hair-follicles.

It may be well also to try and diminish the size of the ectopia by the means adopted by the late Mr. Greig Smith, who, for some weeks previous to operation, kept the patient on his back, and the exposed mucous membrane shielded with green "protective" coated with dextrine, covering this over with boracic lint, and by this means, in one case, the mucous membrane not only became less angry, but its upper half, almost as low as the ureters, became covered with epidermis almost as white as the surrounding skin. In another case, also successfully operated on, no preliminary treatment was of any avail in diminishing the size of the ectopia.

Operation.—An anæsthetic having been given, a median flap[†] is raised from the abdominal wall above the exposed bladder. Its shape resembles that of the wooden portion of a fire-bellows, its length is rather greater than the distance between the root of the penis and the upper margin of the exposed bladder, while its root must be sufficiently broad to ensure a sufficient blood-supply. In raising it, care must be taken not to cut it too thin, and, at the same time, not to go too deeply with the point of the knife, as the tissues here are extremely thin, and the flat, tense, expanded linea alba beneath is often very thin, and thus the peritonæal sac may easily be opened.

The two groin flaps are next made, of rounded oval shape, with broad pedicles, the outer boundary of which is sufficiently carried out on to the thigh, and then on to the root of the scrotum, to ensure its containing the superficial epigastric and the external pudic arteries. The inner margins of these flaps join those for the central flap at about its centre, and are then continued down along the side of the urethral groove for about half its length.

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[*] For full information on all these matters Mr. J. Wood's articles (*Dict. of Surg.*, vol. i. p. 425, and *Med.-Chir. Trans.*, vol. iii. p. 85) should be consulted.

[†] The shape and arrangement of the flaps are excellently shown in pl. ii., figs. 1 and 2, accompanying Mr. Wood's paper (*Med.-Chir. Trans.*, vol. lii). Some illustrations of other flaps in a paper by Mr. Mayo Robson (*Brit. Med. Journ.*, 1885, vol. i. p. 222) will also be found useful. And I would direct my readers' attention to a paper by the late Mr. W. Anderson (*Clin. Soc. Trans.*, vol. xxv. p. 78), which contains, as might be expected, some very helpful drawings.

While these flaps must be cut as thick as possible, care must be taken to avoid any subsequent hernia, and they must be sufficiently detached to meet for their whole length, without tension, in the middle line. In raising them they must be handled as carefully as possible, whether with fingers or with bluntly serrated forceps, so as in no way to impair their vitality. All bleeding having been stopped, the flaps washed with boracic-acid lotion, and their surfaces allowed to become glazed,* the umbilical flap is first taken and folded down, with its skin surface towards the bladder, evenly and without tension. It is then stitched to the cut edge at the root of the penis.

The groin flaps are then drawn inwards, placed with their raw surfaces upon the raw surface of the umbilical flap, and carefully stitched together. The sutures should be many and mixed, of wire, carbolised silk, fishing-gut, and horsehair. Wire has the advantage of being non-irritating and of keeping sweet in a wound which cannot be kept aseptic. The sutures should be left in for a fortnight, and, in the case of children, it may be well to give an anæsthetic to take them out.

The raw surface from which the central flap was taken is then closed, as far as possible, with long hare-lip pins and twisted sutures. The rest of this wound may be closed, now or later on, by Thiersch's method of skin-grafting (Vol. i. p. 188).

The parts are then painted with collodion and iodoform, sal-alembroth gauze applied, and the buttocks and hips smeared with eucalyptus and vaseline. If any redness appear, wet boracic-acid lint dressings should be made use of.

Prof. Trendelenberg (*Centr. f. Chir.*, No. 49, Dec. 1885) published a case of extroversion of the bladder in which immediate union of the lateral margins was obtained by previous division of the sacro-iliac synchondroses. By entirely freeing the joints and breaking their sides free this surgeon has gained an approximation between the anterior superior spines of two inches in a child of two and a-half. This approximation is of course only rendered possible by the fact that the symphysis pubis is deficient in these cases. When the bones are thus approximated the lateral margins of the defect are pared, and brought together with sutures. This, when successful, effects a great saving of time, and secures that the cavity of the bladder shall consist, save for a narrow line of scar in front, of vesical mucous membrane and not of scar-tissue. As a result the formation of phosphatic deposit is greatly diminished. A very interesting account of this operation has been given by Mr. Makins with a successful case (*Trans. Med. Chir. Soc.*, vol. lxxi. p. 191). To be successful the division of the synchondroses should be performed early, *e.g.*, before the child is five.

After-treatment.—The patient must be kept partly sitting, shoulders being well propped up and the knees flexed; a bandage passed from the knees around the shoulders will facilitate this. Any sudden straightening of himself by the patient is fatal to a good result.

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* Spencer Wells's forceps should be left for five or ten minutes on any bleeding points, and all ligatures, even of fine chromic gut, dispensed with, if possible. [illegible] will yield to firm sponge-pressure.

the first few days small opiates or injections of morphia will be required.

(2) **Cysto-Colostomy (Maydl's Operation).**—The abdomen is opened by a vertical incision running down to the mucous membrane of the bladder. The area of the latter, including the trigone, is then carefully dissected up and separated from the rest of the bladder and commencement of the urethra.

A loop of sigmoid is now drawn through the wound, and the abdominal cavity protected by gauze packing. A longitudinal incision of the required length is next made in the right side of the exposed loop of sigmoid, escape of contents being prevented, if necessary, by the application of clamps. The trigone is now rotated through about ninety degrees, so that the ureters now lie above one another instead of side by side, and is attached to the margins of the opening in the sigmoid by means of sutures. Two rows of sutures are required, a deeper one uniting the mucous membrane of bladder and sigmoid, and a superficial row of Lembert's sutures passing through the muscular wall of the bladder and serous and muscular coats of the sigmoid.

Any remaining bladder mucous membrane having been excised, the loop of sigmoid is now dropped back into the abdomen. A tampon of iodoform gauze is then passed down to the site of the anastomosis to provide against possible leakage, and the rest of the wound closed.

HYPOSPADIAS.

Varieties.—These are three, viz.: 1. Glandular.—The opening is here merely farther back than usual, the frænum is absent, the glans broad, flattened, somewhat recurved, and the prepuce, often hood-like, always in a condition of partial paraphimosis. 2. Penile.—Here the urethra is especially liable to open at one of the three following sites: (*a*) Just behind the glans; (*b*) at the middle of the penis; (*c*) at the junction of the penis and scrotum. 3. Scrotal.*—Here the cleft on which the urethra opens may be either at the junction of the penis and scrotum, or involve the scrotum and perinæum, the former being called peno-scrotal, and the latter perinæo-scrotal.

When an operation is under consideration, with a view of rendering micturition and coitus normal, the surgeon must take into due consideration—(*α*) the degree of the deformity; (*β*) whether the penis is fairly developed; (*γ*) whether it is much tied down; (*δ*) whether the testicles are present and descended; (*ε*) how far the patient's condition is made miserable by rawness and eczema due to impeded micturition, and by impeded coitus; and how far there are reasonable hopes of remedying these. Two methods of operating will be described.

1. **Duplay's Operation.**—The operation is divided into the following three stages, which require, in order to be successful, much time and patience on the part of both surgeon and patient:

i. *Straightening the penis and formation of a meatus;* ii. *Formation of*

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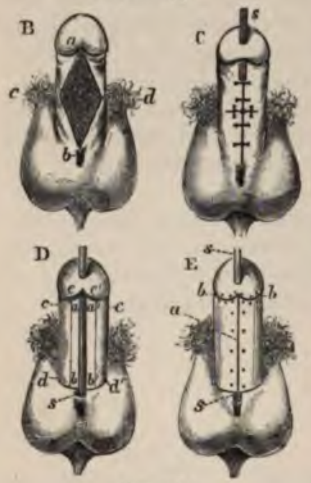
* The above is sometimes divided into two—scrotal and perinæo-scrotal.

a canal from the meatus to the hypospadiac opening; iii. *Junction of the old and new canal.*

FIG. 177.



(Bryant.)

i. *Straightening of the Penis.*—In the penile, peno-, and perinæo-scrotal varieties, the penis, often short, is recurved,* especially during erection, by a band consisting partly of a muco-cutaneous ridge, corresponding to the absent urethra, and reaching from the hypospadiac orifice to the glans. M. Bouisson seems to have first pointed out the importance of dividing this, which he did subcutaneously. M. Duplay recommends division by an open wound, carrying the incision as deeply as needful, and states that the corpora cavernosa may be incised to a very considerable depth, if needful to secure this end. M. Duplay's incision leaves a lozenge-shaped wound, which he unites by sutures (Fig. 177, B and C).

At the same time the above-named surgeon forms a meatus. This is done by paring the two lips of the depression which represents the meatus, and uniting these over a bit of catheter. If the depression be very shallow, an incision upward into the glans-tissue, or two lateral ones, may be needed before it is possible to insert a catheter, and to apply sutures round it.

ii. *Formation of a New Urethra.*†—The penis being held up, two incisions are made a little outside the lateral margins of the mucous surface corresponding to the deficient urethra, and reaching from the glans to the hypospadiac orifice. By making two transverse incisions at either end, two narrow quadrilateral flaps, *a*, *b*, *a'*, *b'* (Fig. 177 D), are dissected up towards the middle line until, with their mucous surfaces turned inwards and their raw surfaces outwards, they meet without tension over, and thus shut in a catheter passed from the previously restored meatus to the hypospadiac orifice. These flaps are now united with sutures, partly of fine chromic gut and partly of fine carbolised silk, cut quite short. From the sides of the penis two similar flaps, *c*, *d*, *c' d'* (Fig. 177 D), are dissected up from within outwards, till they can be sufficiently drawn inwards without tension to cover over the raw surfaces of the internal flaps. They are then carefully united in the middle line (Fig. 177 E). I much prefer horsehair and fishing-gut sutures here, well soaked previously in warm carbolic acid.

In operating upon boys, and I consider nine to fifteen as the best age, I prefer, in penile hypospadias, to make the new glans and restore the floor of the urethra at one sitting. Any points where union fails can be closed later. The chief trouble is the retention of the catheter sufficiently long. I have usually found that after the third day the delicate mucous membrane of a child's bladder resents the catheter—a very little mucus quickly plugs these small instruments—and a nurse must be instructed to pass a small india-rubber catheter every two or three hours. In the intervals a short bit of bougie is kept in the new urethra and glans to maintain the patency of the canal. Iodoform and collodion with a dry dressing of iodoform gauze are the best dressing.

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* This recurving is also in part due to thickening and shortening of the capsule of the corpora cavernosa, and even of the septum.

† Several months, at least five or six, must elapse before the surgeon is certain that no recurving will occur. This disappears very gradually.

Mr. Makins describes (*Lancet*, 1894, vol. ii. p. 1141) a method of restoring the urethra in hypospadias, in which Thiersch's operation is ingeniously modified. By the use of three tiers of suture not only is the new urethra built up firmly, but the prepuce is restored as well.

iii. *Joining the Old and New Urethra.*—As soon as the new urethra is thoroughly established, quite closed, and shows no sign of contraction, this last stage may be undertaken. The edges of the posterior end of the new urethra and those of the remaining orifice having been freely vivified, and a catheter passed from the meatus into the bladder, the opening is closed over it by sutures as in stage ii. A catheter—one of Jaques' pattern is least painful—should be kept in the bladder if possible till all is water-tight.

2. **Russell's Method** (*Brit. Med. Journ.*, Nov. 17, 1900).—Mr. Hamilton Russell, of Melbourne, describes the following method which he has devised and used successfully on a boy, aged 9, the subject of hypospadias of the perinæo-scrotal type. In view of the excellence of the result in the above case, the method is well worth a trial. The operation is performed in two stages, and is described by Mr. Russell as follows:—

First Operation.

A thread is passed through the glans penis to serve as a tenaculum and the glans drawn upwards.

Step I.—An incision through the frænum which binds down the glans. This incision may be carried at once right down the penis, so as to divide the prepuce on the dorsum by a circular sweep, not too close to the corona. The tip of the left index finger is inserted into the gaping wound in the concavity of the penis, and the structures which bind it down are felt and divided by successive cuts with scissors. In this way will be divided a number of dense fibrous bands and portions of the sheaths of the corpora cavernosa, and the scissors must be freely used until the penis is quite released and can be drawn out straight. There will now be a great length of raw surface exposed between the extremity of the perinæal urethra and the glans, and the median sulcus between the corpora cavernosa may be deepened by a little careful dissection, and removal of the remains of the longitudinal fibrous bands that have been divided (Fig. 179; the shaded portion shows the shape of the raw surface exposed).

Step II.—Perforation of the glans for the reception of the glandular urethra:—A tenotomy knife, with the edge turned towards the dorsum of the organ, is thrust through the substance of the glans, close to the under surface; the structure is incised freely towards the dorsum, leaving a capacious channel through its substance.

Step III.—The incision indicated by the dotted lines E E′ (Figs. 179 and 180), starting near to the extremity of the perinæal urethra, about one-third of an inch or less from the cut margin of the skin, the incision is carried, always parallel to the cut margin, over the dorsum of the penis to the corresponding point on the opposite side. By this incision a strip of prepuce will be marked out which surrounds the penis in a manner closely resembling a clergyman's stole (Figs. 179 and 180). This loop of skin is then detached from its connections everywhere except at its extremities, and slipped over the end of the penis, exactly as a clergyman removes his stole. The loop of prepuce is then simply manipulated so that the cutaneous surfaces are placed in apposition, the raw surfaces being turned outwards; a sinus-forceps is passed through the channel in the glans, the loop seized and pulled through (Fig. 181). The redundant portion of the loop is then cut off, and the two lateral portions of the new urethra fixed in position by one or two stitches at the meatus (Fig. 182).

FIG. 178.

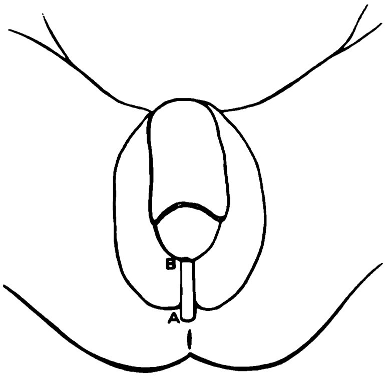
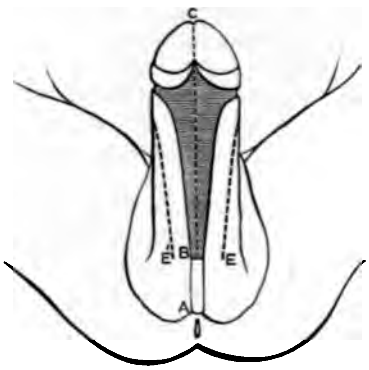
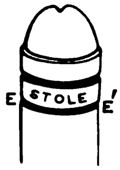


FIG. 179.



Step IV.—Adjustment and suturing of the preputial flaps.—On the dorsum of the penis this is just a simple procedure, as in circumcision. On the under surface of the organ, where the prepuce is made to cover over the two edges of the new urethra, these edges should be included in the sutures, so that in each suture four cutaneous edges are brought together, namely, two of prepuce and two of new urethra (Fig. 181). Before finally tying these sutures, inspection should be made of the spot where the perinæal urethra becomes continuous with the new penile urethra; a nipple-like projection of skin is likely to be present at this place and should be snipped off with scissors.

FIG. 180.



The posterior (or dorsal) edges of the new urethra will be adjusted in the mesial sulcus between the corpora cavernosa, and will not require any suturing. The sutures having been tied, a narrow bandage of iodoform gauze may be then wound round the organ, and left undisturbed for several days. The result, when completed, is portrayed in Fig. 182. It is scarcely necessary to remark that no rod of any kind should be inserted in the new urethra. Should there be any defect in the success of this operation, it would be wise to remedy it before finally proceeding to the closure of the perinæal urethra.

Second Operation: Supra-pubic Cystotomy and Closure of the Perinæal Urethra.

This last is really by far the most difficult part of the whole procedure, and demands care, skill, and experience in this kind of plastic work. To the operator who brings these qualities to the task, however, success will come easily. There is one point of paramount importance to the success of this part of the operation. It is necessary to define accurately the ridge where the urethral mucous membrane merges into the skin of the perinæum; the separation between the two must be made exactly at this ridge, and it is best accomplished by taking a delicate pair of scissors and cutting off the crest of the ridge all the way round. It will be necessary to incise the skin of the perinæum posteriorly to a small extent, in order to expose the hinder margin of the urethral orifice. The reason for such great precision on this point is, that if any of the perinæal skin be left attached to the urethral margin at any spot, the attempt at closure will certainly fail at this point; while if, on the other hand, the incision is so made as to leave any portion of the urethral wall attached to the perinæal skin, that will be a sacrifice of urethral wall which can by no means be afforded. The edges of the urethra should now fall naturally together when the thighs are approximated, and they need not be sutured. The perinæal skin should be undercut slightly and approximated by a few sutures, and the wound dressed with a layer of gauze and collodion. Should healing have taken place throughout, the bladder drain may be removed in a fortnight.

FIG. 181.

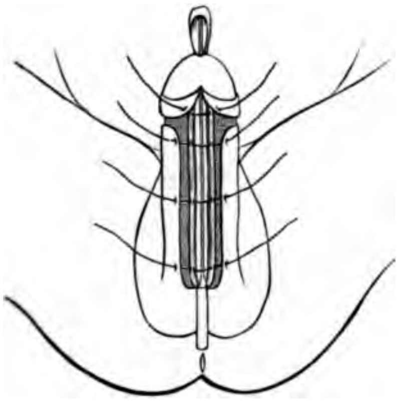
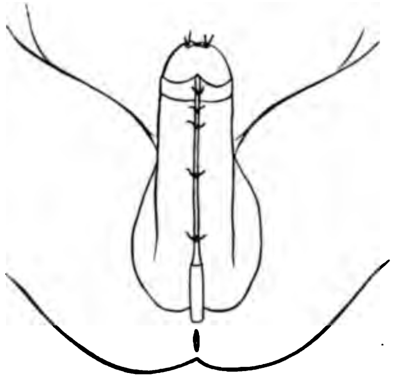


FIG. 182.



EPISPADIAS.

I shall not give any really full account of the different attempts to cure this rare condition. For some points of practical importance I would refer my readers to the remarks on Hypospadias (p. 451).

Any attempt at curing epispadias should be divided into three stages, thus:—

i. *Straightening the Penis.*—While the penis is short, recurved, so as to lie in contact with the abdominal wall, it is no use trying to complete the defective urethra. Attempts should be made to straighten the penis by dividing it subcutaneously close to the pubes, each corpus cavernosum being cut separately. In the only case in which I practised this, in a patient, aged 17, the hæmorrhage was easily controlled by dry gauze and light pressure, but very sharp tenotomes must be employed, as the erectile tissue offers much less resistance than a tendon. Each corpus cavernosum should be divided completely, and as cleanly as possible. The penis must, for some time, be kept fastened down; improvement in its position takes place gradually, together with increase in its length, this being, eventually, more marked the earlier the operation is performed.

ii. *Completion of the Deficient Urethra from the Meatus to the Epispadiac Opening.*—The simplest way of effecting this is by the method of Thiersch and Duplay, much as in hypospadias, to the account of which I would refer my readers. Two narrow quadrilateral flaps, extending from the meatus to the epispadiac orifice, are marked out and dissected up from without inwards on either side of the open urethra, both being left attached in the middle line. These, turned with their mucocutaneous surface inwards, over a small Jaques' catheter, to form the new urethra, and their raw surfaces outwards, are united in the middle line with numerous points of sutures cut short and buried (p. 452). Thin flaps dissected up from within outwards from off the dorsum and sides of the penis are then drawn inwards, raw surfaces being thus opposed to raw surfaces, and kept *in situ* by numerous points of suture.

iii. *Junction of the Old and New Canal by Closure of the Epispadiac Opening.*—This is effected by freely refreshing the surrounding parts and suturing them carefully. Before the union is complete several operations may be required, both for this condition and hypospadias.

A modification of Russell's operation for hypospadias might also be used here.

CIRCUMCISION (Figs. 183, 184, 185).

Trivial as this operation seems, it is so important, especially in adults, to secure speedy healing, that it will be briefly alluded to here.

Indications.—This operation is still not practised often enough, especially amongst poorer patients, where many practitioners still treat phimosis as a matter of but little importance. Hospital surgeons have, only too often, opportunities of seeing the following results follow from the above course:—(*a*) Balanitis and adhesions. (*b*) Paraphimosis, from the forcible retraction of a phimosed prepuce. (*c*) From the impediment to micturition, urethral and vesical irritation, and even cystitis, may be set up, simulating the symptoms of stone. (*d*) Hernia and prolapsus recti. (*e*) The sexual feelings too early induced, and bad habits.*

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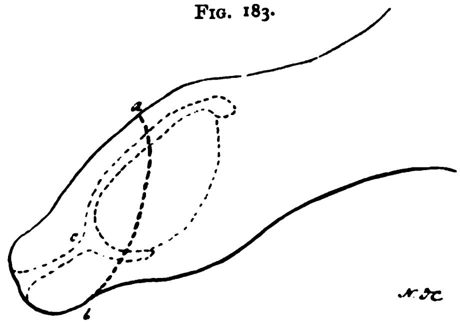
* Prof. Sayre (*Orthopædic Surgery*, p. 14) describes cases in which paralysis of certain groups of muscles, leading to talipes and other deformities, followed on early sexual excitement, due to phimosis. See also the case recorded by Mr. Hilton (*Rest and Pain*, p. 276).

(*f*) Impediments to intercourse. (*g*) Intensified gonorrhœa, chancres, &c. (*h*) Epithelioma.

Operation.—This may be performed in many different ways, but the following points must be remembered in every case: (1) To remove enough of the mucous layer of the prepuce. If this be not done, some tension on the glans remains, and this leads, especially in adults, to troublesome erections which interfere very much with the process of healing; later on, some degree of phimosis is certain to persist. (2) Not to leave too much tissue about the frænum.

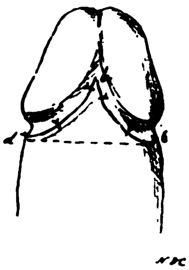
Mr. Howse (*Guy's Hosp. Reports*, 1873, p. 239) has drawn attention to the fact that the cellular tissue at this spot is loose, and that the presence of the frænal artery makes probable the gathering of blood and inflammatory effusion at this spot. In children this is a matter of less importance, but in adults it may lead to the formation of a tediously persistent lump, interfering with the function of the organ.

Fig. 183.



a, b, Shows the line of incision by which the prepuce is removed. *c*, The point of constriction of the mucous membrane which causes the phimosis. The finer dotted line shows the mucous membrane lining the prepuce and covering the glans. (Davies-Colley.)

Fig. 184.

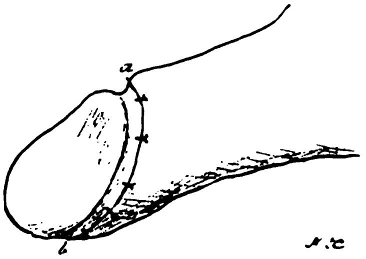


The pointed process of skin (*b*) is shown adjusted in the angle left by the remains of the frænum. The dotted line (*b, d, e*) shows the edge left on the skin and the triangular bare surface which has to heal by granulation unless precautions are taken to preserve the triangular flap of skin as directed above. (Davies-Colley.)

(3) Not to remove too much of the prepuce. Thus, it is always well, in adults especially, to leave enough to cover easily the sensitive papillæ with which the corona abounds. Again, in the diminutive penis of infants, it is very easy to remove so much as to nearly flay the body of the organ.

The following is a very simple mode of operating: The prepuce having been separated as much as possible from the glans with the finger and thumb, or a stout probe, a pair of dressing-forceps is lightly placed on the penis at a level with the corona; the glans being next allowed to slip back, the forceps are closed, and all the prepuce in front of the instrument is cut off with a sharp scalpel used with a rapid sawing movement. The following directions given by Mr. Davies-Colley (*Guy's Hosp. Rep.*, 1892, p. 164) are worth remembering at this early and most important stage of the operation: "The incision should begin upon the dorsum, at a point corresponding to that part of the glans which is halfway between the meatus and corona. The incision should be made downwards and forwards, so as to leave a sharp point in the middle of the under surface (Figs. 183, 184). The object of this pointed projection is to fill up, subsequently the triangular interval, which is otherwise left when the portion of the mucous membrane of the prepuce, to which the frænum is attached, is removed. The blades being at once removed, the mucous membrane is then slit up with a director and scissors or a sharp-pointed bistoury,* this incision running up to, but not beyond, the corona. The mucous membrane, if still adherent, must be peeled in two flaps from off the glans, this detachment being effected by the finger and thumb, or by a stout probe swept round. The cut edges of the prepuce are then rounded off with scissors, which follow the curve of the glans as far as the frænum. Just a frill of mucous membrane, and no more, should be left all the way round the corona (Fig. 185). Enough prepuce should be left to cover over the corona-papillæ, and to admit of easy stitching. Chromic gut and horsehair make the best sutures. Very fine needles should be used, and the sutures passed quickly through skin and mucous membrane with a stabbing movement, and without bruising the edges with forceps. In passing the sutures any bleeding-points must be transfixed, and the abundant cellular tissue kept in its place with the point of a probe. This cellular tissue must on no account be cut away, as in it run the vessels to the prepuce. All bleeding must be stopped, especially in adults, or extravasation of blood in the loose connective tissue leads to tension, cutting through of sutures, and sloughing. The frænum is now attended to, the prepuce which is still attached there being cut away carefully by V-shaped cuts, pointing forwards, and leaving just enough flaps to carry the sutures and no more. The frænal artery can usually be secured by transfixing it with one of the sutures; if not, it is readily tied with a fine chromic-gut ligature.

Fig. 185.



The penis after the edge of skin has been sutured to the frill of mucous membrane left along the corona. (Davies-Colley.)

I much prefer interrupted sutures of chromic gut for circumcision; a continuous suture often gives good results in healthy subjects, but the former has the great advantage that one or two can be removed, if needful, without interfering with the rest. The majority soften away.

One of the following dressings will be found the best. I like most of all the dry gauze dressing advised by Mr. Ballance (*St. Thomas's Hosp. Reports*, vol. xvi. p. 198), kept in place by iodoform and collodion. When the parts are at all swollen, or where erections are likely to be troublesome, I prefer boracic-acid dressings, two layers of boracic-acid lint wrung out of an iced saturated solution of the lotion. The deeper layer has a hole cut to allow of micturition and is only removed by the surgeon, the outer one envelopes the whole penis, and may be removed and re-wetted by the patient, though usually it is sufficient for him to keep it wet by dropping on a little lotion from time to time. For children and hospital practice I have come to the conclusion that, on the whole, nothing answers better than carbolic oil. The dressing is not disturbed for two or three days, and the mother has instructions to keep it moist by oil dropped on at intervals.

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* It is well at this stage to make tension on the loose prepuce with two pairs of dissecting forceps, and thus secure a clean section.

After circumcision the patient should rest as much as possible. Thus, an adult should stay in bed for forty-eight hours and keep on the sofa for a week, alternate stitches being removed at intervals. If he insist on getting about too early, he must run the risk of the parts remaining long œdematous and tender. And for this reason, with hospital patients, who have to come backwards and forwards, early and complete healing is not to be expected.

AMPUTATION OF THE PENIS (Figs. 186-189).

Indication.—*Epithelioma of Penis.*—I would refer my readers to the remarks made in Vol. i. p. 448, on the pre-cancerous stage in epithelioma of the tongue. Though epithelioma of the penis is much less common, lives are, here also, too often lost by allowing the case to get beyond this stage. Any suspicious excoriation, ulceration, or wart should be early destroyed with the acid nitrate of mercury, or excised. Where, after this treatment, satisfactory healing does not take place, early and thorough removal of the part should be performed. There should be no dangerous waiting, because the surgeon is unable to satisfy himself whether the case is one of inflammatory induration or infiltration from new growth. In such cases, especially where there is a doubtful history of syphilis, much valuable time has been often lost with drugs, which, even if the lesion does date back to some long-past syphilis, are quite useless if epitheliomatous ulceration has set in. Furthermore, the longer ulceration continues, the more extensively will the inguinal glands be involved. In such cases, though the penis may be satisfactorily operated upon, disappointment will speedily follow, owing to the outbreak in the inguinal regions. Scarcely any surgical case presents a close more distressing, both to the patient and those around him, than one of breaking down of epitheliomatous glands, owing to the hideous · ulceration, the noisome discharge, and the steady decay of bodily strength.

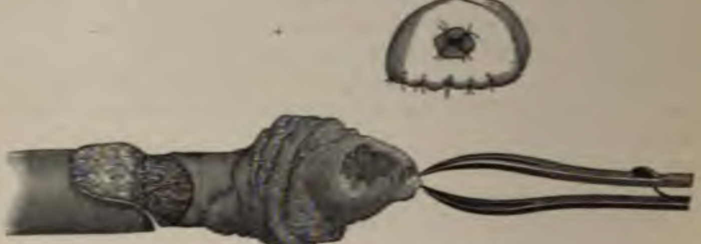
In a very few cases, when the disease commences around the meatus, it may still be possible to remove the affected part without interfering with the body of the penis. It seldom happens, however, that we see the case early enough for this, and it is usually necessary to remove the whole of the glans and more or less of the corpora cavernosa. Before doing this the prepuce, unless it admits of being retracted, should invariably be laid open, so as to expose the growth and make quite sure of its real nature.

Operations.

I. **Galvanic Cautery.**—I am as much against this method here as in the case of the tongue (Vol. i. p. 464). The dread of hæmorrhage still induces some to resort to it; it is not, however, a sure preventive. Sharp bleeding has followed a few hours after the operation, and also, later on, during the detachment of sloughs; furthermore, this operation leaves a much more troublesome and sloughy wound than the knife.

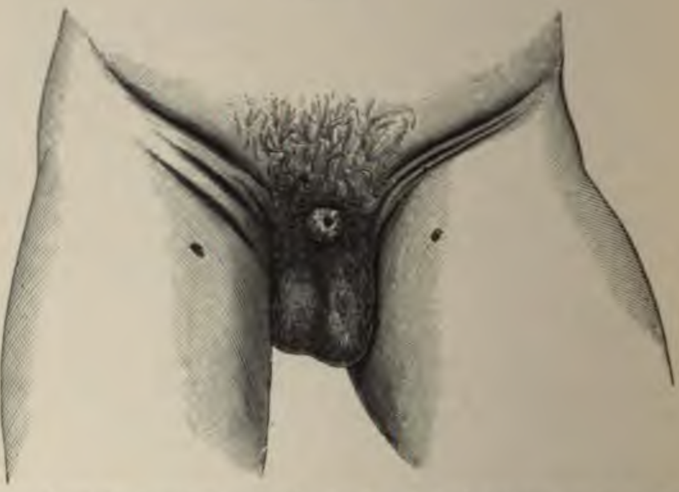
This is not a matter of slight importance in these patients, in whom, usually advanced in years or prematurely aged, pulled down in health, and often depressed in mind, tedious healing of the wound (which it is difficult to keep sweet) involves keeping the patient on his back for a considerable time, with the risks of broncho-pneumonia, erysipelas, &c. The need of a special, expensive instrument, and the unpleasant fœtor of the operation, are also objections.

FIG. 186.



Flap amputation of the penis. The appearance of the stump, with the urethra slit up and stitched *in situ*, is shown above. The flap has been raised too near the disease below.

FIG. 187.



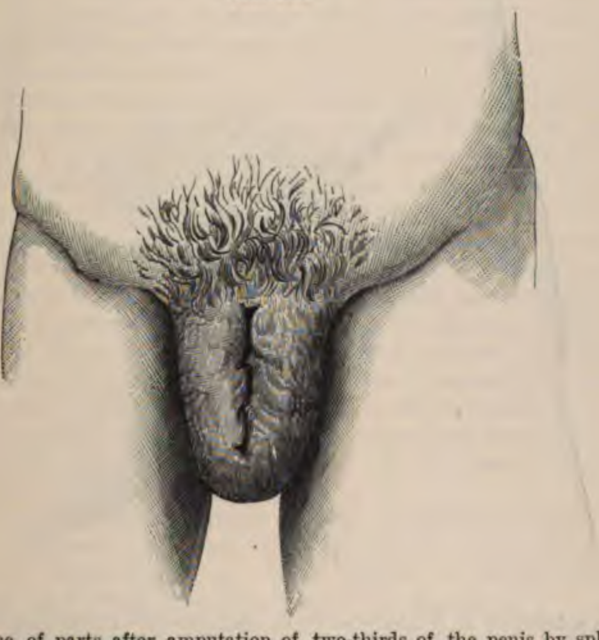
A case of amputation of the penis by the flap method one year and a half after the operation. Scars of operations for the removal of glands (enlarged inguinal glands were removed at the time of the operation) are seen in either groin. The two dots mark the points where drainage tubes were brought out. The patient died two years after the amputation of gland disease. There never was any recurrence in the penis. (*Diseases of Male Organs of Generation.*)

If the surgeon make use of it, a No. 4 or 6 catheter should first be passed; the loop of wire is then tightened around the penis, well behind the disease, and kept there by one or two pins. When the current is passed care must be taken that by tightening the wire very slowly, and watching the amount of heat, the vascular structures are not severed too quickly; otherwise hæmorrhage, very difficult to arrest on a seared surface, is certain to follow. The catheter is cut through by the heated wire, and the urethra, thus maintained patent, is slit up and stitched as directed below.

II. **Circular Amputation.**—This gives good results, though not equal, in my opinion, to those which follow the flap method. The vessels being commanded the skin is drawn a little forward to prevent any superabundance afterwards, and the amputation is effected by a single sweep of the knife. The vessels and the urethra are treated as directed below.

III. **Flap Amputation** (Figs. 186, 187).—This method has been followed by rapid healing, and has given an excellently covered stump in the eleven cases in which I have made use of it. Hæmorrhage having been provided against by one of the above-given means, the surgeon enters a narrow-bladed knife, at a point well behind the disease, between the corpus spongiosum and the corpora cavernosa, and then cuts forward and downwards for about three-quarters of an inch. From this small inferior flap the urethra is dissected out. A flap of skin is now cut from the dorsum and sides of the penis, resembling in miniature the upper skin-flap in amputation of the thigh. This flap being held back, the corpora cavernosa are divided vertically upwards on a level with the point of transfixion. Any vessels which can be seen are now tied with chromic gut or carbolised silk. On removal of the drainage-tube,

FIG. 188.

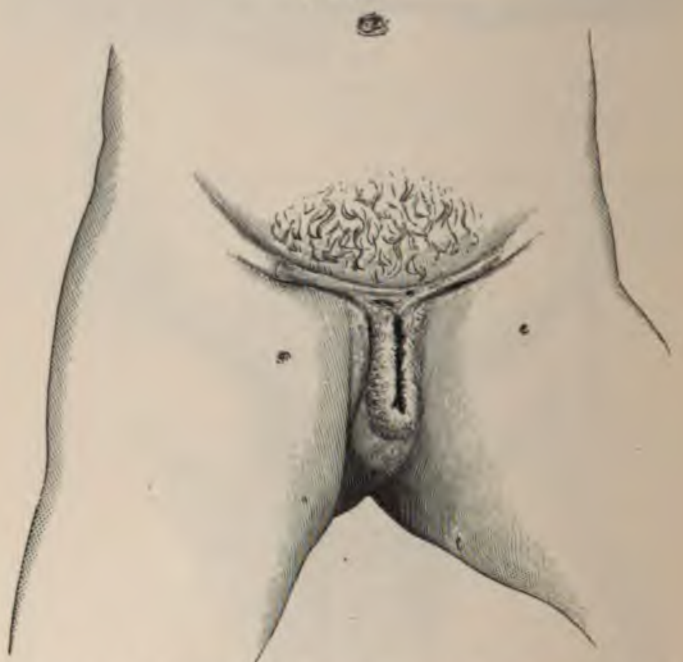


Appearance of parts after amputation of two-thirds of the penis by splitting the scrotum. The patient refused castration. The urethra is at the lowest part of the scar. (*Diseases of Male Organs of Generation.*)

clamped with Spencer Wells's forceps, and securing any spirti vessels, free oozing often takes place, but ceases spontaneously. hæmorrhage being arrested, the upper flap is punctured, and the uret drawn through the face of the flap, slit up, and stitched *in situ*. T two flaps, upper and lower, are then united by a few points of carboli silk and horsehair suture.

This method secures a natural skin-covering for the severed corpor cavernosa, and prevents the delay and irritation which healing by granulation entails. A similar operation was, long ago, suggested by Prof. Miller, of Edinburgh, but this surgeon cut his flap from below. If, as I have recommended, the flap is taken from above, the skin will be found to fall into position more readily over the raw surfaces of the corpora cavernosa. After all these operations the patient should pass a short piece of bougie at regular intervals.

FIG. 189.



The appearance of the parts a month after complete amputation of the penis, castration, and removal of enlarged glands. The opening of the urethra is not seen, being situated at the perinæo-scrotal junction. The dots mark the counter-punctures for drainage-tubes. (*Diseases of Male Organs of Generation.*)

Occasionally, **severer operations** are entirely justifiable.

Thus, where the penis is involved as far back as the scrotum, the entire penis should be extirpated, if the inguinal glands are not seriously involved, and if the powers of repair are satisfactory. The patient being in lithotomy position, the scrotum is to be split deeply along the whole length of the raphé, and the corpus spongiosum carefully dissected out. This step may be facilitated by passing a large sound.

When the triangular ligament is exposed, the above instrument is removed, and the corpus spongiosum which has been dissected out is cut through, enough being left to bring out in the perinæum. By means of a blunt dissector, the crura are then detached on either side from the pubic arch, and the incision being prolonged around the penis above, the suspensory ligament is divided, and the dorsal arteries secured. The cut end of the corpus spongiosum is now slit up and stitched in the posterior part of the scrotal incision, and all the rest of the wound closed by sutures. Drainage must be provided by a small tube, or by horse-hair drains. Similar operations to the above have been performed on several occasions, but the important modification of dissecting off the crura, and thus ensuring complete removal of the cancerous organ and its capsule, was brought before the notice of English surgeons by Mr Gould (*Lancet*, 1882, May 20, p. 821).

In most cases of amputation of the penis the patients will be wise in consenting to castration—an operation which will add in many cases largely to their comfort, and at a very slightly increased risk. (Wheelhouse, *Brit. Med. Journ.*, 1886, vol. i. p. 187.)

Question of Removing Enlarged Glands.—These should always be extirpated at the same time as the amputation of the penis, together with as much of the lymphatic vessels and surrounding cellular tissue as possible, preferably in one piece in order to avoid the escape of cancer cells into the wound. As long as the glands are involved by growth only, hard and separate from each other, it will be comparatively easy to accomplish this, and thereby add materially to the prolongation of the patient's life. But where they contain not only secondary deposits, but also inflammatory matter, owing to ulceration having set in at the seat of the primary lesion, satisfactory removal of the glands is always a matter of great difficulty and often impossible, owing to their softness and tendency to break down, to their adhesions to their capsules, and the matting of these to the surrounding parts, the vascularity of which is increased, and tendency of the overlying skin to become adherent.

In all such operations the parts should be disturbed as little as possible, as erysipelas, sloughing, and superficial gangrene are very likely to follow these operations where planes of fascia are much interfered with, and where the blood-supply is but poor.

The wound may be irrigated from time to time during the operation with a solution of mercury perchloride, 1 in 4000.

Iodoform and sal-alembroth gauze dressings, or boracic-acid lotion, if erysipelas is feared, will be found the best.

For much fuller information on this and many other points I may refer my readers to my *Diseases of the Male Organs of Generation*, pp. 707-745.

CHAPTER XIII.

OPERATIONS ON THE SCROTUM AND TESTICLE.

RADICAL CURE OF HYDROCELE.*—VARIOCELE.—CASTRATION.—ORCHIDOPEXY.—VASECTOMY.

RADICAL CURE OF HYDROCELE.

IN a paper written twenty-four years ago (*Lancet*, Sept. 1, 1877), I drew attention to the uncertainty of the radical cure of hydrocele by iodine injection, as usually practised. Thus, out of forty-four cases treated with solutions of iodine and potassium iodide at Guy's Hospital, I found that the treatment failed in eight cases, and that in two it failed twice.

Latterly, I believe that surgeons have recognised that the risk of recurrence is greater than that of excessive inflammation, and thus stronger solutions have been made use of—*e.g.*, the Edinburgh tincture of iodine—and some of the injection has been allowed to remain. As it is still a fact, however, that no one method of cure can always be relied upon as radical for this troublesome complaint the three following will be mentioned here—viz.:

i. **Iodine Injection.** ii. **Injection of Carbolic Acid.** iii. and iv. **Partial Excision.**

Iodine Injection.—Supposing the patient be healthy, not prematurely aged, and amenable to directions, the surgeon often begins with this as less painful, requiring no open wound or dressing, and finally, as necessitating much less the recumbent position.

I have at p. 466 drawn attention to the frequency with which recurrence is liable to take place if dilute injections are used. Elsewhere I have written as follows: "While I believe that the absolute certainty of iodine injection has been over-estimated, yet there is no doubt that failure is too often courted by want of the following precautions:—(*a*) The use of a too dilute solution; (*b*) Not bringing the solution in contact with the whole of the sac; (*c*) Not withdrawing all the hydrocele fluid; (*d*) Injecting large hydroceles immediately after they are emptied; (*e*) Making use of iodine in unsuitable cases—viz., hydroceles with thick walls.

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* The methods of injection given below refer to hydrocele of the tunica vaginalis and to encysted hydrocele. Antiseptic incision and partial excision of the sac is applicable to all varieties of hydroceles, including the congenital.

The method of injection with iodine should be carried out as follows: The patient's bowels are cleared out for a day or two before, and it is well for him to rest with his hydrocele well supported for twenty-four hours previous to the injection. The fluid is first most carefully drawn off with a medium-sized trocar,* the surgeon then, by means of a syringe with a platinum nozzle accurately fitting the cannula, injects steadily 2 to 3 dr. of the tincture of iodine (*Edin. Pharm.*), taking care first that the cannula is well within the cavity of the tunica vaginalis. I now plug the cannula with a small wooden spigot, while the affected side of the scrotum is gently manipulated and shaken so as to bring the fluid in contact with all the interstices and folds of the serous membrane. In five or ten minutes the cannula is withdrawn, as in most cases it is quite safe to leave in the above given amount of iodine. The puncture is kept carefully closed around the cannula while this is taken out, and then closed with iodoform and collodion. A feeling of heat is noticed during the injection, sometimes amounting to sickening pain, referred also to the inguinal and lumbar regions, and the neck of the bladder. Faintness is not very infrequent, and it is thus well to tap and inject the patient while he stands at the end of a sofa, or lies down.

The after-treatment depends on the amount of inflammation. In most cases there is too little rather than too much of this. It usually appears within two or three hours, and if it be slight or delayed, the patient should be told to walk about a little, and the sac again frequently manipulated. The patient should be kept to his bed or sofa for a day or two, the scrotum supported, and plain diet given. There should be no hurry to employ ice, this only being made use of if the swelling threatens to be great. Morphia may be given freely. Within four or five days, usually, the patient may get about wearing a suspender. He should be prepared for a return of the swelling after the injection, otherwise he will be disappointed at what he considers a recurrence of his disease. The swelling, as a rule, disappears in three to four weeks.

In the case of a double hydrocele, if the patient be healthy and not advanced in years, it is quite safe to inject both sacs at the same time, but in elderly or weakly subjects, antiseptic incision will be the safest course if the patient desires an operation, otherwise an interval should be allowed between the two tappings.

Carbolic Acid.—This method was introduced in 1881, by Dr. Levis, of Philadelphia (*Boston Med. and Surg. Journ.*, 1881, vol. cv. p. 540). The following *advantages* have been claimed, and in my opinion largely substantiated: (*a*) It is less painful than iodine. (*β*) It is more certain. Thus, carbolic acid produces almost uniformly the proper degree of inflammation, neither falling short nor exceeding that needful for producing plastic lymph. (*γ*) There is less risk of sloughing. (*δ*) The patient is only kept from his employment for a day or two, and sometimes for a shorter time than this, or even not at all.

While the above advantages of carbolic-acid injection over that by iodine, especially the fact that it entails a much shorter rest and absence

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* By some a solution of cocaine is now injected. I prefer not to use this, if possible, so that no dilution of the iodine injection may occur.

[illegible] substantiated, it is [illegible] less frequent, [illegible] partisans of this method [illegible] **Recurrence.**—With regard to this [illegible] a large number of cases have been [illegible] introduction of [illegible] radical cure [illegible] the remarks [illegible] hydroceles, and [illegible] period before a [illegible] bounds of proba[illegible] incision and [illegible] excision of the sac, [illegible] permanently successful. [illegible] America itself, where this [illegible] surgeons have had [illegible] are not in entire [illegible]

Thus, Dr. Bull, of New York [illegible] July 1886, p. 55), in a paper [illegible] writes, "It is a striking fact that of the thirteen cases I have met with, two had been treated unsuccessfully in this way. As it attempts a cure by the same process as that induced by iodine, an adhesive inflammation, I see no reason to believe that it will ever yield much better results." Dr. R. F. Weir, in the discussion that followed on the reading of the above paper, said he had used carbolic-acid injections over sixty times. Occasionally relapses had occurred, not in a large proportion, however, as he could recall only four or five instances, and in these the patients were cured by a repetition of the same treatment. In three of those the injection was repeated too soon, as subsequent experience showed that a longer delay would probably have resulted in a cure. Helferich, of Griefswald (*Therap. Monatsch. cit.* 1890), has tested carbolic-acid injection by Levis' method in over thirty cases, with known results in twenty-seven: twenty-one were cured, six relapsed: all of these latter, save one, being cured by a fresh injection.*

(2) **Much Reaction. Cellulitis and Suppuration.**—It is right to say that in some of the cases in which this has followed on the injection of carbolic acid an excessive quantity seems to have been employed. Thus, Dr. R. Abbe (*New York Med. Journ.*, December 22, 1883), reports that he injected three drachms of carbolic acid and glycerine into a large hydrocele sac, and that acute suppuration followed, requiring incision, which cured the hydrocele. He allows that the above quantity is excessive, one drachm always sufficing. Dr. Weir (*loc. supra cit.*), in one case in which the iodine treatment had failed, injected three drachms of carbolic acid: this was followed by the usual absence of pain, but with recurrence of the swelling in a few days, which went on to suppuration, and after incision of the sac, shreds and large masses of membrane were discharged, gangrene of nearly the entire tunica vaginalis being produced.

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* Mr. Southam (*Lancet*, 1887, vol. ii. p 515) mentions a case which recurred within the month of the injection with carbolic acid, and was then treated by antiseptic incision and partial excision of the sac.

The above cases of Weir and Helferich show that accidents have followed even when the amount of carbolic acid used is small. They suggest that, considering the comparatively recent introduction of this method, and the restricted number of surgeons by whom it has been used, complications are at least as frequent as after iodine injection.

(3) **Carbolic Acid Poisoning.**—Most writers have distinctly stated that this does not occur. It is certainly extremely rare, as it is probable the surfaces are sealed by the carbolic acid.

But Dr. J. Murphy, at a discussion at the New York Association (*New York Med. Record*, June 20, 1891), said he had known of three or four cases in which carbolic acid used in this way was followed by bad effects, especially on the kidneys. He had seen one case terminate fatally, and he could not attribute this death to anything but carbolic acid poisoning. He did not know how much carbolic acid was used.

The Injection.—After the usual tapping, Dr. Levis, by means of a syringe which has a nozzle sufficiently long and slender to reach entirely through the cannula, injects about *a drachm (of crystals) of carbolic acid*, which must be kept liquid by a five or ten per cent. addition of glycerine or water. The former should be preferred. No more fluid is to be used for dilution than is absolutely necessary. Liquefaction by heat is inadmissible, as solidification is in this case liable to follow in the cannula. As soon as the carbolic acid is lodged in the sac, the scrotum is freely manipulated, so as to diffuse the carbolic acid uniformly. A sense of warmth is produced, quickly followed by decided numbness.

My own experience is too limited to be of any value. Of late years I have used antiseptic incision with partial excision of the sac, and have been so well satisfied with it as to prefer to use it wherever the patient can lay up. But where this is objected to, I have used iodine and carbolic acid, but the latter only in eleven cases. None have recurred to my knowledge, and some have been watched for over three years. There is no need of Levis's special instrument. What is essential is to use carbolic acid liquefied with glycerine, not to inject more than one drachm, and to lodge it well within the tunica vaginalis. This may be done by means of one of the large exploring hypodermic needles, which hold 60—100 minims.*

The needle attached to the syringe is first lodged safely in the cavity of the hydrocele, which is then tapped in the ordinary way with a fine hydrocele-trocar. When the sac has been thoroughly emptied, the cannula is withdrawn, and the syringe, previously cleansed, containing the solution must be screwed on to the needle, which has been kept *in situ*, and the solution injected. However this is done the carbolic acid must be brought in as complete contact as possible with the interior of the sac, by manipulating the scrotum, turning this from side to side, upside down, &c. I have employed strapping or suspension with cotton wool packing later, as after the use of iodine.

Partial Excision of the Sac.—This latter is often spoken of as excision of the tunica vaginalis. As the parietal layer of the serous membrane can alone be removed, I prefer the above title.

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* I learnt the value of these in small hydroceles, as in those of the cord, or the infantile variety in boys, from the late Mr. Berkeley Hill (*Brit. Med. Journ.*, 1886, vol. i. p. 1164). Following Mr. Hill, I have also given an anæsthetic in children.

A. **Advantages.**

(1) Its greater **certainty.** While it is right to remember that no method can be absolutely relied upon as radical, and that hydroceles have recurred even after incision and partial excision of the sac,* there can be little doubt that this must be extremely rare, since after efficient removal of the parietal layer of the tunica vaginalis, the cavity must, with very few exceptions, be entirely obliterated. A method which further removes a large part of this secreting surface must *à priori* be surer than those methods which do their work as it were in the dark, in which the drainage must needs be imperfect, the quantity of the irritant employed necessarily limited, it being thus always left doubtful how far the injection has been weakened by dilution or chemical change, and how far folds of the inner surface of the tunica vaginalis have escaped inflammation at all. On this account I prefer to make use of partial excision in all cases where the general condition of the patient is satisfactory, and where he is willing to lay up for a short time.

The **cases** to which this method appears to me to be **especially suitable** are those where (*a*) iodine or carbolic acid has previously failed, (*β*) where the sac is very large or has very thick walls. Where the sac is simply very large, but not much thickened, it can be safely and successfully injected, if this is preferred, by tapping first and then allowing only an interval of two or three weeks to elapse before the sac is injected. But if the walls are much thickened, there are the risks that after tapping they cannot collapse readily, and so be brought in contact with the irritant, and, while in a sac like this it is always uncertain if the due amount of inflammation will be secured, there is also a risk that owing to the little vascularity of a thickened sac sloughing may take place. (*γ*) Where, on account of ill-health or age, the risk of inflammation after injection of an irritant is especially to be dreaded. (*δ*) Where the surgeon is desirous of exploring the sac of the tunica vaginalis, as in cases where enlargement of the testis of a doubtful nature coexists with hydrocele, and does not yield to ordinary treatment, where a hæmatocele has supervened on a hydrocele, or in the much rarer cases of loose bodies in the sac of the tunica vaginalis. (*ε*) Where several hydroceles co-exist—*e.g.*, either double hydrocele of the tunica vaginalis, or a vaginal and encysted hydrocele. (*ζ*) In certain cases of hydrocele complicated with hernia—*e.g.*, (1) in young subjects where a radical cure of both is desired, (2) in much older patients, where the hernia is irreducible, where, especially in unhealthy patients, there is a risk of the inflammation set up by the injection extending to the sac of the hernia. (*η*) In cases of congenital hydrocele a careful incision with antiseptic precautions will be safer than any other method of radical cure if the pressure of a truss for the obliteration of the communication with the peritonæal sac cannot be persevered with. And the same course will be wise in the case of encysted hydroceles of the cord, when their important surroundings, mobility, and their difficult fixation before injection are considered.

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* On this point a valuable paper by Mr. H. Morris, followed by an interesting discussion (Med.-Chir. Soc., Feb. 28, 1888), should be consulted (*Brit. Med. Journ.*, March 3, 1888). Two cases of recurrence after partial excision of the sac were related. Mr Pollock mentioned one even more extraordinary. This recurred repeatedly—*i.e.*, after two injections with iodine, the introduction of a silver wire seton and "ample suppuration": finally, the sac was laid open and lint inserted for a fortnight. The hydrocele again recurred, and the patient declined any further treatment than simple tapping.

(B) The **disadvantages** of this method must next be considered. (1) As pointed out in my paper in 1877, it undoubtedly involves more **trouble** than that by injection. While it can be completed in a quarter of an hour, an anæsthetic will be required, and there is also the trouble of the subsequent dressings, and there is also more need of absolute rest. Thus the patient will be confined to his bed for a week or ten days, and after this will have to keep quiet on a sofa or in an armchair. (2) With regard to the amount of **subsequent orchitis, pain,** swelling, &c., I am of opinion that this varies, but not as much as after iodine injection. In the early days of this method—the Schnitt method of Volkmann—when after incision of the tunica vaginalis this cavity was carefully plugged with strips of aseptic gauze to promote changes in the serous membrane, orchitis to a painful degree was not uncommon; but of late years when, after incision of the sac, the parietal layer of the tunica vaginalis is gently detached from the scrotum and cut away close to the epididymis and the testis, I have been extremely struck by the very small amount of pain suffered, in spite of the disturbance and the handling entailed of the parts concerned. (3) With regard to **the duration of the after-treatment,** this is in favour, but not so distinctly as would appear at first sight, of the injection method. With regard to the injection of carbolic acid, this is most certainly so (p. 465). Iodine has also an advantage in time less clearly marked. Thus, after injection with carbolic acid, the patient may perhaps not have to lay up at all. After forty-eight hours he will probably be able to follow his employment if not an arduous one. After the use of iodine the patient will probably be able to get about after the first week. But these dates are only approximate; even with regard to carbolic acid it is impossible to read through a large number of cases reported by American and other surgeons without seeing that inflammatory reaction, crippling to locomotion, does occur more frequently than would be gathered from the reports of those surgeons who have advocated it most strongly. And again, as is shown above, while carbolic acid is extremely convenient, it is clear that there is no absolute certainty about it, and that repeated injections have been called for in many cases. After iodine injection the scrotum is often not its natural size, and the patient not free from all encumbrance till between the second and the third week. By the latter date, after partial excision of the sac, the patient will be quite well and able to get about. (4) As to the risks of hæmorrhage, cellulitis, and sloughing, which have been described by some writers, I can only say that I have never seen them in an experience of twenty-one cases of antiseptic incision, and of antiseptic incision and excision of the sac.

Operation.—The patient having been prepared for the operation, the parts shaved and well cleansed with soap and water used with a flannel, and then washed with a dilute solution of carbolic acid or mercury perchloride,* ether, or A.C.E. is given. The surgeon, the scrotal tunics being made tense by his left hand or by an assistant,[*] incises them down to the hydrocele, from the top to the bottom of the swelling, and then, before opening this, arrests any bleeding points by applying Spencer Wells's forceps. The hydrocele is then opened sufficiently to admit a finger, which makes out definitely the position of the testicle; the tunica vaginalis is then freely but carefully slit up with blunt-pointed scissors. As, when the hydrocele is opened, the fluid escapes with much force, the sac at once collapses into folds, and scissors will be found preferable to the knife. The incision into the tunica vaginalis should be as free as is safe, for a free incision will at once admit of rapid removal of the parietal layer and a thorough examination of the recesses of the serous sac. If a small one only is made, owing to the contraction of the dartos, the above steps will be found impossible. Further, a large incision is, by the above, soon folded into a little space, and heals as quickly as a small one. Spencer Wells's forceps are then applied to every bleeding point in the cut edges of the sac. The forceps on either side serving to widely open out the wound, the testis and epididymis are examined for any cysts, sometimes present about the head of the latter. The inner surface of the tunica vaginalis is carefully scrutinised for any fibrous bodies attached or loose in any of its folds, or for false membranes and thickenings. As any of these may, by keeping up irritation, lead to a recurrence of the hydrocele, they should be dealt with, the cysts being snipped away after ligature of their pedicles with fine catgut. The parietal layer of the tunica vaginalis is now gently detached, or peeled away from the scrotum as far as is safe—*i.e.*, close up to the epididymis on the outer, and to the back of the testicle on the inner side. Along these limits it is snipped away with scissors, and forceps applied to all bleeding points. (*Vide* Fig. 190.)

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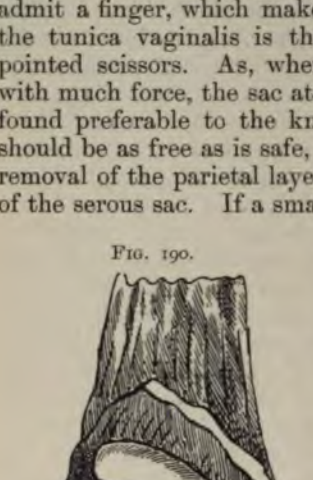
* As it is of the utmost importance that there should be no irritation, or erythema set up, which may cause discomfort and subsequent restlessness and also suppuration and slowness of healing, the antiseptic solutions, which are all irritants, should be used both before or during the operation, as dilute as is safe to the very delicate scrotal skin

Fig. 190.



Radical cure of hydrocele. To show the extent to which the tunica vaginalis is removed. (From Lockwood's *Hernia, Hydrocele, and Varicocele.*

If any false membranes are now present over the testicle and epididymis or the small part of the parietal tunica vaginalis that remains, these are to be detached with a sharp spoon. The bleeding which follows may be smart and require very hot solutions of mercury perchloride, or firm pressure with a sponge. Different ways of closing the wound have been employed. In all my cases I have followed Bergmann,

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—*e.g.*, carbolic acid 1 in 30, and mercury perchloride 1 in 4000. For the same reason no scrubbing with a nail-brush is advisable. These may seem trifles, but they may have a very important bearing on the after-result. To promote relaxation of the dartos and prevent contraction, and thus curling in of the skin, warm solutions should be used.

[*] The position of the testis should first be made out by translucency. The more showy step of opening the hydrocele at one cut might endanger the cord and testicle.

and, having cut away the serous sac freely, have sutured its edges to those of the skin with stitches of fine catgut. But I have gone farther, knowing how rebellious some hydroceles are (p. 468), and I have, after thus suturing the tunica vaginalis and skin, wiped over, once, and very lightly, what is left of the parietal layer of the latter and the visceral layer on the testicle, with silver nitrate. I have not found that this has been subsequently followed by orchitis or pain.

Mr. Lockwood recommends that the top of the incision should be a full inch from the root of the penis; that any upward prolongation of the hydrocele along the cord should be dissected out; that in cases where the origin is doubtful, or where the hydrocele is large and of long standing, and the testicle may be wasted, it is wise to obtain permission beforehand to remove the testis. Mr. Lockwood finds it easier to separate the tunica vaginalis while still distended. It is, he believes, quite unnecessary to paint the tunica vaginalis vera with chemical irritants, or to injure it mechanically. On this point readers should refer to the footnote at p. 468.

Instead of suturing the tunica vaginalis (as above described) many surgeons prefer to simply let the testicle drop back into the scrotum, and to close the skin wound in the usual way, leaving a small drainage-tube in the cavity for the first twenty-four hours. Drainage is necessary here since some oozing nearly always takes place into the loose cellular tissue, and if an exit is not provided for this a large hæmatoma may form. Immediate closure of the whole wound in this way results in more rapid healing and earlier convalescence. The sutures having been introduced, it only remains to dust a little iodoform over the wound, dry this most scrupulously, and apply the dressings. Whatever material is used care must be taken that the dressings should supply the following conditions—viz., they must be aseptic, duly compressive, and unirritating. I have been in the habit of using green protective and iodoform gauze, secured in place by firm and even bandaging with a double spica. While this is applied, care must be taken that the scrotum is kept well up on to the pubes. This is a cardinal point, and must be attended to not only now, but later on, at and after each dressing. It prevents œdema, bagging, and inflammation, and thus also pain, and hastens rapid repair of the wound. When the dressings are *in situ*, a pad of carbolised tow should be kept over the anus, to prevent flatus or fæces contaminating the closely adjacent wound. If the skin incision has been closed, the wound will be healed in a week; but if Bergmann's plan is adopted, a longer time will be required for this. On the third or fourth day most of the sutures uniting the skin and tunica vaginalis should be cut and removed; by the fifth or seventh day the patient may get on to a sofa, and by a date varying from the fourteenth to the twenty-first day he may usually begin to get about, with a suspender, and the small remaining wound protected by a sealed dressing (some sal-alembroth or iodoform gauze sealed on with collodion) changed every few days, or by one of iodoform or resin ointment. As the repair with aseptic wounds is rapid, but often filamentous and weakly, I advise the use of a suspender for six months or a year after the operation, and longer if occasions arise for hard exercise, such as riding, &c.

VARICOCELE.

Indications.—While palliative treatment will be sufficient in the great majority of cases, if, at the same time, due attention is paid to the general health, the occupation and habits of the patient, and, where this is required, to his sexual hygiene, an operation will be justifiable in the following cases:

(1) Where the patient is precluded from entering one of the public services, or any occupation involving much activity in the upright position. Thus, out of the twenty-eight cases in which I have operated, twelve were private cases, of which nine were applying and passed into the army and navy, and one was a medical man, operated upon for double varicocele; of sixteen hospital cases, one was desirous of entering the police and subsequently did so; one was a goods-guard on probation and found that a large left-sided varicocele threatened to spoil his prospects, the aching pain, which invariably followed the jumping in and out of his brake van, being only relieved by the patient's lying down, and being inevitably brought on again by the next station. This man stopped me on London Bridge some five years after, to say that he was in regular employment as a goods-guard, married, and the father of two children. Five others were shop assistants, and two were gardeners. (2) In any case where the varicocele persists or steadily increases, in spite of treatment, and where it is accompanied with much distress, annoyance or pain, or where it interferes with some justifiable pursuit, such as riding; (3) where the surgeon has satisfied himself that the testicle is undergoing atrophy; (4) where the varicocele is accompanied by frequent seminal emissions and much mental misery. In the two last given indications, great caution must be shown before operation is resorted to, and the last is the most doubtful of all. Where the patient is clearly a hypochondriac, or a monomaniac in genital matters, no operation is, of course, to be thought of. It is certain to be a failure.

The choice of operation is a very large one, but as I consider that one alone has been proved to be alike efficient and simple, I shall not occupy my space with an account of any others, or with the history of the operation. Like so much else in operative surgery, the only efficient and simple operation for varicocele dates to the great discovery of Lord Lister.*

Excision.—This operation, performed with the parts well in sight, has the very great advantage of allowing the surgeon to carry out each step with precision, to include what he thinks safe, and no more: it does away with the risk of transfixing a vein, and its possibly disastrous results of septic thrombosis; it requires very few and simple instruments; while Lord Lister's teaching has enabled us to perform it without the risks of hæmorrhage, cellulitis and blood-poisoning, which were so terribly frequent in operations on veins performed before his day.

For a few days before, the bowels should be kept well open, and the diet should be light and limited. The parts should be shaved and thoroughly cleansed with soap and water, and then lotio hydr. perch.

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* Mr. Howse drew attention to the method of aseptic excision in varicocele (*Guy's Hosp. Reports*, 1887, vol. xxiii. p. 408).

1—4000 (p. 469). It is well to perform the cleansing a few hours before, and to keep a compress, wet with the above lotion, on up to the time of the operation. The patient having been anæsthetised with ether or A.C.E. mixture, the vas deferens is isolated, and either kept so by two fingers of the left hand, or handed over to an assistant, who stands on the opposite side to the surgeon. In either case the latter makes the veins prominent by grasping the affected side of the scrotum and protruding the varicocele. The skin incision, which should be about an inch and a half long, may be made in one or two ways, either in the scrotum directly over the site of the varicocele, or above the scrotum and in front, commencing at the external abdominal ring and running downwards towards the scrotum. If the latter plan is adopted it will be found that the varicocele is quite easily pushed up into the wound, and it has the advantages of rendering the operation more convenient, whilst the wound is more easily sutured and heals more certainly and readily than one which involves the skin of the lower part of the scrotum.

Care should be taken to avoid opening the tunica vaginalis; if, however, it is opened, the opening should be taken up with Spencer Wells's forceps and tied up with fine catgut, or it may be left without treatment. If the wound runs an aseptic course, this complication will give very little trouble. With one or two strokes of a keen-edged scalpel the packet of veins is exposed and is then carefully opened. The surgeon then passes a steel director, first at the upper and then at the lower angle of the wound through the packet so as to leave about a third of the veins behind it; along the director, which thus keeps a track open and easily found, an aneurysm-needle, or eyed-probe, carrying a medium-sized ligature of sterilised silk, is passed. This is then tied firmly round the included veins. If the incision has been made an inch and a half long, and the upper and lower angles of the wound are well retracted, no difficulty will be experienced in placing these ligatures near enough to the external abdominal ring and testicle respectively to ensure removal of a sufficient extent of the enlarged veins. After each of the ligatures, upper and lower, has been tied securely and cut short, a pair of scissors is run along the director, and the packet is cut through about a quarter of an inch from each ligature. The portion of varicocele thus included is then removed by carefully clipping it out with a pair of scissors; any cross branches which may now be divided are secured with fine chromic gut. An extremely important step comes next. With a sharp-pointed half-curved needle, carrying medium-sized chromic gut, the surgeon brings into accurate apposition the two ends of the stumps, the ligature being passed through the centre of each stump close to the corresponding ligature. As it is tightened, an assistant, with a sharp-pointed probe, brings the cut ends of the veins on the face of each stump snugly and precisely together. The object of this most important detail is to permanently shorten the cord, and to restore the natural suspension of the testicle. It would obviously be quite impossible in any subcutaneous method. I have practised this detail since 1887, but as Mr. Bennett was the first to draw attention to this step (*Lancet*, Feb. 1891), the credit of showing the importance of it must be his. A little iodoform having been dusted in, the sutured cord is replaced in the bottom of the wound. When the skin is much relaxed, I finish the operation by removing widely, by two elliptical incisions, the skin on either side of the small wound which has been made, the apex of the incisions being placed well up over the external ring. I think it well to adopt this step, as I believe it helps to brace up the relaxed parts; but it is not of the least use by itself, and it is much less needed now if the above-given precaution of ligaturing together the vein-stumps, and thus shortening the cord, is taken. And the same may be said of another step which should be taken before the close of the operation—*i.e.*, ligature and removal of any very enlarged scrotal veins, a step which I always adopt when the patient's attention has dwelt on these. The whole wound, superficial and deep, is then carefully scrutinised, and every bleeding-point being secured is thoroughly dried. The edges of the wound are then carefully adjusted with silk or horsehair sutures, the tendency to inversion being borne in mind.

Dressings of green protective and iodoform gauze are then applied, due facilities being provided for the patient's micturition. In securing the dressings *in situ*, care should be taken to keep the scrotum well up on to the pubes by bringing the turns of the spica from below upwards and not in the reverse direction. I generally change the dressings at the end of the third day, immediately after the first action of the bowels, and again at the end of the first week, to remove alternate sutures. At this date the patients may get on to a sofa, but I insist on their maintaining the recumbent position for two or three weeks. Aseptic union, forming quickly and without the medium of granulations, remains weak for a long time. If the stumps of the cord have been sutured together there is much less need for the patient to wear a suspender afterwards; but to give the operation every chance, and to save all drag and tax upon parts which have very recently united, I generally advise that a suspender be worn for three months. In addition to the support which I believe to be advisable while the sutured stumps of the cord are being firmly knit together, I am of opinion that the continuance of support to the parts for a while prevents a too rapid melting away of the little nodular mass, which, callus-like, marks the seat of the operation.

The points to which I attach most importance in the operation are maintenance of strict asepsis throughout, suturing together the two stumps, and so shortening the cord and providing for suspension of the testicle; arrest of all hæmorrhage, thorough drying out of the wound, the use of a horsehair drain if the parts have been much disturbed, and the careful application of an antiseptic dressing, so as to keep the scrotum well up on to the pubes. I look upon these details as most necessary if rapid healing is to be made certain of, and cellulitis, epididymo-orchitis, and hydrocele prevented.

Mr. Bennett (*loc. supra cit.*), in his operation for varicocele, advocates some different and, in two instances, far more radical steps; thus (*a*), he does not open the general sheath immediately surrounding the veins, as by leaving it intact he makes certain of passing the ligature around *all* the affected veins, as none of these ever lie outside the fascia. Furthermore, the fascia, if not opened, better carries the weight[*] of the dependent testicle. (β) Mr. Bennett considers that the view generally held that the spermatic artery is displaced with the vas deferens, and thus kept out of the way, is a mistake; in reality the artery remains with the veins. Furthermore, Mr. Bennett holds that the artery is usually and may always be safely divided with the veins, for as long as the wound remains aseptic the artery to the vas deferens, "and some outlying branches of the spermatic artery, one of which sometimes comes off high up and so may easily escape division, are sufficient to carry on the blood supply to the testicle, and to prevent any risk of atrophy."

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[*] This is rendered of less importance by the suture which unites the vein stumps.

While Mr. Bennett's plan is justified by the results obtained by his own practised hands, I feel that, writing as I am for those who may not have had many opportunities of operating for varicocele, I ought to point out certain grave risks which I consider to be at least possible, if the above teaching is widely followed.

First, as to division of *all* the veins, I will say at once that perhaps I am prejudiced unduly by the unfortunate result of one case, which I mention below. While I admit that recurrence of the varicocele may be brought about by removal of too few of the veins, I feel strongly that inclusion of all of them in the ligature involves a much graver risk. Further, I cannot agree with Mr. Bennett that it is safe to trust to the artery of the vas, or branches of the spermatic which may come off sufficiently high up to be available, and some small unimportant anastomotic branches passing from the sub-vaginal tissue. Mr. Bennett allows that these vessels are small and delicate, and points out that any inflammation about the parts may be sufficient to choke them, sloughing or wasting of the organ following as a necessary result.

Thus, while in no way criticising Mr. Bennett's modifications of the operation when practised by himself, I strongly advise my junior readers to make use of the simpler and very efficient method given at p. 472.

The chief risks and causes of failure in the operation are as follows:—

I. Sepsis and its Results.—The risk of these was always present with the old subcutaneous operations, however modified; it is by no means to be lost sight of with the open operation performed with the advantages of modern surgery. A good instance of sepsis and its dangers is recorded by Mr. H. Lee (*Clin. Soc. Trans.*, vol. i. p. 73). Here erysipelas, repeated hæmorrhages, sloughing of the skin of the scrotum and penis, and multiple abscesses, followed on Mr. Lee's operation of subcutaneous division of the veins between two pins secured with figure-of-eight sutures. Mr. Lee also mentioned cases in which abscesses, localised sloughing of the skin, and, on two or three occasions, arterial hæmorrhage, controlled by introducing a third pin, had happened in his experienced hands. It is certain that other operators have not been so candid.

II. Inclusion of too many Veins.—That this is a real danger is shown by a case of mine which I published (*Syst. of Surg.*, vol. iii., p. 571). The patient here had a double varicocele, that on the left side being truly colossal. It was my third case, and was operated on with precisely the same precautions as to the vas and to the maintenance of asepsis as those given above (p. 472), save that the carbolic spray was used instead of irrigation. Owing to the huge size of the varicocele three bundles of veins were removed, and even then a large number appeared to be left, the varicocele being a quarter of its former size. The case did well up to the eighth day, when the wound opened, and the lower half of the testis, evidently gangrenous, presented itself. This was cut away after the application of a chromic gut ligature. Though, at the close of the operation, it did not appear that too many veins had been removed, such must have been the case. I am certain no injury was inflicted upon the vas deferens; throughout the operation this was entrusted to very careful hands, those of Dr. B. N. Rake, at that time my dresser, lately of Trinidad, and one of our chief authorities on leprosy, whose untimely death has cut short so much excellent work.

III. **Recurrence of the Varicocele.**—I am of opinion that if operation-cases were more thoroughly followed up afterwards, this sequela would be found to be more common than is thought to be the case. It is especially likely to follow the subcutaneous method, where the patient is allowed to get up, or is hurried out of the hospital to make room for another case as soon as the wound is healed. To prevent this risk of recurrence Mr. Bennett lays stress on the need of removing the entire plexus of spermatic veins. As I have been unfortunate enough to meet with a case in which, in spite of care taken, too many veins were ligatured and removed, I cannot agree with Mr. Bennett (p. 475). Another instance of what appears to be recurrence, but which is really an escape of the upper part of the spermatic plexus, may be due to the upper ligature being applied too low down (Bennett). In this case the part of the plexus between the upper ligature and the external ring remains full, and may give trouble for a time, though it gradually shrinks.

Insecure knotting of the ligature, or not using reliable material,* may, of course, lead to recurrence after any method in which ligatures are used but the veins are not also divided.

CASTRATION (Fig. 191).

Indications.

1. *Growths of the Testicle.*

Diagnosis of Malignant Disease of the Testis.—As the records of surgery contain many instances of mistakes under able hands—hæmatoceles removed for malignant disease, and malignant disease opened for hæmatocele, a few hints may not be out of place here on the subject of castration.

Contra-indications.—Castration should not be performed when the cord is extensively involved; when masses can be felt deep-seated in the iliac fossa and lumbar region; when there is any evidence that the liver or lungs are involved; or when the jaundiced sallow tint and rapid emaciation point to the disease having become general. In cases at all advanced, though the patient might be rid of an encumbrance, the operation would be very liable to be followed by a low form of peritonitis, or, before the wound was healed, swelling would probably appear in the inguinal region, and the growth soon fungate through the wound.

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* Mr. Bennett prefers kangaroo-tail tendon ligatures.

The following are the points on which most reliance may be placed: Continuous, and often quickly progressing solid enlargement of the testicle or epididymis without inflammation. Sometimes this progress is much slower; occasionally it may seem to be in abeyance, but careful watching with frequent examinations (and these are the key to obscure cases) will show that the enlargement is progressing in spite of treatment. Failure of well-directed treatment: where the swelling is small, still oval in shape, and smooth and firm in outline, a brief trial of mercury or potassium iodide may be made, combined with carefully applied Leslie's strapping, but where in a week there is no result, or where the case is of longer duration, and delay will very likely be fatal, an exploratory incision with antiseptic precautions, followed, if need be, by immediate castration, will be the wiser course.* Consistence.—This is rarely for long the same all over the swelling. Even if a firm, slow growth seem uniform and recall orchitis, a careful examination will usually find one or two spots which are more *elastic* than the rest. Usually the softening at places where cystic or degenerative changes are taking place is well marked. But it may require somewhat prolonged watching to detect one or two at first lowly rising projections or bosses which foretell that the tunica albuginea is becoming thinned at this spot. Of enlargement of the cord,† fulness of the scrotal veins, adhesion of the scrotal tunics, increasing aches and painfulness I say nothing, as they are evidence that the disease is entering into a later stage.

An exploratory incision is to be preferred to the use of a trocar, as being more certain to give information.

A trocar may enter a solid part or withdraw some scanty mucoid fluid. Sometimes the amount of blood which flows through the cannula of a trocar thrust into a testicle, the subject of rapidly growing malignant disease, is so great as to lead to the supposition that it must be a hæmatocele. In such cases, however, the diminution of the swelling is not so proportionate to the flow of blood as it would be in hæmatocele. Furthermore, the blood is usually bright, not dark and altered as in hæmatoceles.

Prognosis.—It will be seen that the prognosis is always grave, extremely so in the softer and more rapid growths. Kocher goes so far as to say with regard to these that no case of really permanent cure of encephaloid carcinoma is known. In medullary sarcomata, especially in children, the prognosis is almost as gloomy. But while the above opinion is only too true of the majority of cases, a sufficient number have been recorded to show the benefit which may follow on castration, even in the soft forms of sarcomata.

Mr. Meade, of Bradford, removed, in 1846, the testicle of a patient, aged 40, for a swelling which had lasted about nine months (*Lond. Med. Gaz.*, vol. xliv. p. 702). Nine years later, the patient remained free from any return of the disease. In the Museum of St. George's Hospital is a specimen of a testicle converted into a mass of soft malignant growth, with large caseating patches, which Mr. Cæsar Hawkins removed from a patient, aged 45, the enlargement having lasted two years. Twelve years later this patient was alive, and in good health. In the *Med. Times and Gaz.*, 1886, vol. ii. p. 287, a case of Mr. Cock's is mentioned in which a patient remained in good health for six years after castration for "medullary cancer," being then lost sight of in consequence of his emigration to Australia.

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* I may warn my younger readers of the temporary improvement which potassium iodide sometimes seems to bring about even in malignant swellings.

† I quite agree with Mr. Butlin (*loc. supra cit.*) that *early* enlargement of the cord is met with in inflammatory conditions of the testicle, and is, here, a contra-indication to malignant disease.

While these cases are most encouraging, I fear they are exceptional. It will be noticed that in one a swelling had lasted nine months, and in another two years. If it be thought that such cases show that no limit can be fixed beyond which castration must be useless, the following must be remembered. First, is it possible that the earlier enlargement was, for some time at least, inflammatory? Secondly, as a rule, in the softer sarcomata, enlargement of the lumbar glands will be present by the end of the first year of the growth, and often earlier.

As a rule, the retro-peritoneal glands and viscera will be involved by extension and secondary deposits within six months of the time of castration. And this result is the more disappointing because the testicle, a free, floating organ, and one placed independently in a fibrous capsule, appears to be remarkably favourably placed for the radical removal of malignant disease. The intimate association of the organ with the lymphatic system, both within itself and with those within the abdomen, and the facility with which these are early implicated, handicap us terribly here.

But if, as happens most frequently, the disease recurs elsewhere after castration, a useful life may yet be prolonged, the patient, rid of a wearisome encumbrance, is made more comfortable, and towards the close, death from internal deposits of malignant disease is not accompanied with the same distress both to the patient and those around him as when the disease is situated externally. In proof of the temporary benefit of castration, Mr. Curling (*Diseases of the Testis*, p. 342) relates the case of an eminent barrister, who, for two years and a half after the removal of a testicle for soft cancer, was able to continue the practice of his profession to the great advantage of his family, death ultimately taking place from extension to the lumbar glands.

II. *Tubercular Testicle.*—I am of opinion that castration should be performed much earlier in this disease than is usually the practice. Natural cures are so few, dissemination is so frequent and so grave, whether to bladder and kidneys, vesiculæ seminales, or prostate, or to the lungs, while, on the other hand, castration is nowadays so safe an operation, that it should not be deferred.

Early phthisis should not interfere with removal of a tubercular testis which resists treatment and prevents the patient getting open-air exercise, and weakens his health by discharge. Owing to the condition of the lungs, chloroform should be here given, instead of ether.

Tubercular disease of the prostate is a source, usually, of such extreme misery, that any existing cause in the testis should be removed very early. Moreover, from what we have learnt from castration in enlarged prostate (p. 479), removal of tubercular testes may prevent or greatly delay deposit of tubercle in the prostate.

I have only space to mention briefly the **indications**: (1) Where erasion fails in lesions still limited to the epididymis. If one or more discharging fistulæ still persist here, especially if the patient is not in a position to avail himself of a repetition of erasion at the seaside, castration should be performed, slight as the mischief appears to be, especially if they affect the patient's health or interfere with the outdoor exercise so necessary in these cases. It is only too probable that minute deposits are already making their way into the testicle itself by spreading along the rete, a condition impossible to recognise by external manipulation. (2) Where after erasion any fistula has healed, but careful watching of the patient, always to be insisted on, detects the existence of, it may be slight but persistent swelling in the scrotum, with night sweats and loss of flesh. These may point to mischief in the remains of the sexual gland, and not necessarily to disease in the prostate, &c., or in the lungs. (3) Where the body of the testicle is involved. When this remains enlarged, and liable to attacks of inflammation, castration should be performed. (4) Where the testicle remains atrophied and riddled with fistulæ, one or more of which persist in discharging, removal of a useless and dangerous organ should be practised. (5) When a hydrocele* is present, especially if purulent.

III. *Syphilitic Testis.*—Here, owing to the specifics which we possess, castration is much more rarely called for. The indications can readily be judged of from those above given.

IV. *Old Hæmatocele.*

Indications.—Failure of previous treatment, especially in a man of middle life whose activity—*e.g.*, in riding—is much interfered with.

The frequency with which malignant disease follows on repeated injury and irritation of the testicle is well known (Rindfleisch, *Path. Hist.*, vol. ii. p. 197).

V. *Retained Testis.*

Indications.—1. When such a testis is the seat of malignant disease. 2. When it seriously cripples the patient by the recurrent attacks of inflammation associated with it. 3. When a co-existing hernia cannot be kept up by a truss, owing to the presence of the testis.

VI. *Enlarged Prostate.*

This operation has of late years been much resorted to, chiefly through the work done by Prof. J. William White,† of Philadelphia (*Ann. of Surg.*, 1893, and July 1895).

The following are the chief of Prof. White's conclusions:

(i) Clinical experience shows that in a very large proportion of cases (87 per cent.) rapid atrophy of the prostatic enlargement follows the operation, and that disappearance or great lessening of long-standing cystitis (52 per cent.), more or less return of vesical contractility (66 per cent.), amelioration of the most troublesome symptoms (83 per cent.), and a return to local conditions not far removed from normal (46 per cent.), may be expected in a considerable number of cases.

(ii.) The mortality is 18 per cent. If patients are operated upon under surgically favourable conditions—*i.e.*, before the actual onset of uræmia, or before the kidneys have become disorganised by backward pressure and infection—Prof. White thinks that the mortality will be only 7·1 per cent. The following appear to be some of the chief causes of a fatal issue. (1) Sepsis. This is very likely when it is difficult to prevent occasional dribbling of urine. (2) When mania or mental aberration follows. As this has followed in a small proportion of cases it must always be reckoned with. (3) Results of kidney failure, a complication always present in these cases, and especially to be feared when the operation is called for in long-standing and advanced cases of enlarged prostate. In such, the operation will be considered by the friends to be the actual cause of death; in reality it merely fails to save life.* (4) Causes of death, common to any operation performed in the aged, such as hemiplegia, and cardiac failure.

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* On the subject of tubercular hydrocele, of the influence of co-existing disease in the vesiculæ seminales, prostate, and lungs, on castration, I must refer my readers to chapter vi. of *The Diseases of the Male Organs of Generation.*

† Ramm, of Christiania, seems to have been the first to perform the operation (*Centr. f. Chir.*, Sept. 2, 1893), but it is to Dr. White that our profession is indebted for first collecting and publishing with unmistakable clearness the evidence, clinical, pathological and experimental, which would justify a resort to this operation.

(iii.) Comparison with other operative procedures. Compared with prostatectomy, the very much smaller risk, the greater simplicity, ease, and quickness of castration, the far smaller amount of anæsthetic, are too obvious advantages of castration to need more than mention. As to drainage, castration does away with the inconveniences of any fistula, and the noisome leakage which may be inseparable from it. On the other hand is the repugnance which so many men, even when well on in life, feel towards parting with their testicles, a repugnance which we shall often have to meet, and which will frequently baffle us, but one for which the patient alone must be responsible, when it has been clearly put before him how, having advancing enlargement of the prostate, he stands on the brink of a precipice, and that it requires very little indeed to send him over.

(iv.) As to unilateral castration, Dr. White considered the evidence contradictory, and the operation worthy of further investigation. There is no doubt that in some cases it has been followed by unilateral atrophy of the prostate, and in two cases at least by very marked improvement of symptoms.

(v.) As to ligature or division of the vasa deferentia, Dr. White's experiments on dogs have shown that in nearly every case there was commencing and considerable loss of weight of the prostate. These results appear anomalous and require confirmation.

(vi.) Ligature of the vascular constituents of the cord, or of the whole cord, produces atrophy of the prostate; but in Dr. White's experiments only after first causing disorganisation of the testes.

The above conclusions have been to a large extent justified, although in the light of more recent experience they should be to some extent modified.

Owing to the more careful selection of patients the mortality has been decidedly diminished. In a collection of 159 cases by Dr. Alfred C. Wood (*Ann. of Surg.*, September 1900) the mortality was 8 per cent., or 10 per cent. less than in Prof. White's list. This is practically the reduction in mortality that Prof. White predicted.

Although some degree of improvement has taken place in most of the cases (over 90 per cent., according to Wood's tables) the actual amount of benefit has not been perhaps so great as would be expected from Prof. White's conclusions; it has, nevertheless, been sufficient to place this method of treatment on a sound basis.

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* In Mr. H. Fenwick's words (*Med. Ann.*, 1896, p. 508). "There is every reason to believe that unsuitable and unfavourable cases have been chosen in the first wild rush which is so unreasonably made at every innovation. Uræmic and even dying patients have been castrated."

The cases in which, in my opinion, the operation is most called for, fall into two groups. (A) *The more urgent.* Where (1) previous appropriate treatment, carefully carried out, has failed; (2) where there have been one or more attacks of retention; or (3) where hæmorrhage has taken place. In either case the peril of cystitis, too often fatal here, is enormously increased: (4) Where there is inability to micturate, or where this is painful and frequent; (5) where the passage of the catheter is increasingly difficult with the risks of hæmorrhage, formation of false passages, &c.; (6) where the prostate is soft and elastic, not densely hard and fibrous—in such cases marked relief may be expected. Of course, the greater the power of voluntary micturition which remains, the more natural the urine as to urea, sp. gr., albumen, and sugar, the greater the rallying power of the patient, and the clearer the mind the better the prognosis. (B) *Less urgent cases.* Here the operation is prospective and preventive. The patient is younger, the power of voluntary micturition is still good, there is no cystitis, but palliative treatment fails to relieve the frequent disturbances at *night*, and hæmaturia has begun to occur at intervals. Here the surgeon is abundantly justified in advising the operation as a preventive of worse things which are certain to come. The operation will not be often accepted here, but it is in such cases that it will give the best results.

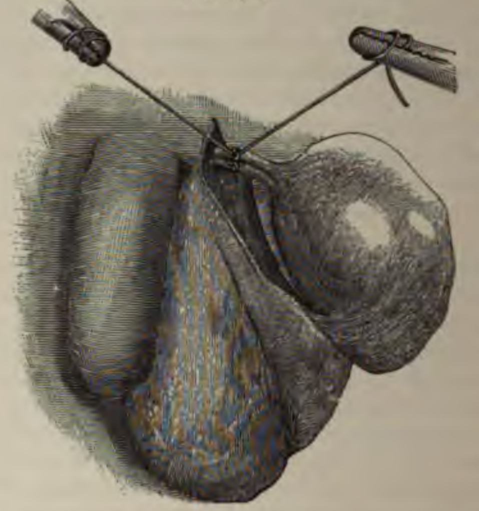
As to the amount of relief which we can promise our patients, we shall do well to be cautious while hopeful, deciding each case by itself very carefully, especially as regards these two factors, (α) the amount of voluntary micturition and control which this operation will restore must largely depend upon the condition of the bladder, how far long-standing cystitis or habitual use of the catheter has damaged its walls, replacing the muscular by fibrous tissue, and converting it into an inelastic thick-walled sac. (β) The state of the prostate. The more vascular, the softer, the more rich in glandular tissue this is, the more decided will be the shrinking that follows castration. On the other hand, the denser and more fibrous the gland, the longer delayed certainly, and, probably, the less marked will be the benefit. It should be remembered also, as pointed out by Albarran, that six or twelve months may elapse before the full benefit is attained, according to the condition of the prostate.

Operation.—I have nothing to add to the account fully given below, save that both testicles should be removed through one incision in the scrotal raphé. As soon as the superficial fascia is divided, cutting a little to each side will admit of each testicle being shelled out. Each cord should be divided immediately above the testicle, and the whole operation conducted with as little disturbance of the parts as possible. This method leaves only one wound to heal, a point of some importance in broken-down patients, where the feeble mental power may lead to restlessness, disturbance of the dressings, sepsis, &c. In those cases where there is dribbling of urine and the scrotum is liable to be wet, the usual incision should be made on one side, and both testicles removed through this wound. The patient should then be turned on to his other side, so that the penis hangs away from the wound, and the dressings well protected with jaconet.

Much rarer indications are:—VII. *Insanity, chronic epilepsy, &c., kept up by onanism.*[*] VIII. *Injury.* IX. *The radical cure of hernia—i.e.,* when the operation cannot be completed without removal of the testis, owing to the firm adhesions of the sac to the cord, especially when this occurs in a patient approaching middle-age. It is always well, here, to obtain leave for castration.

Operation (Fig. 191).—The absence of any hernia on the side operated on having been ascertained, and the parts duly shaved and cleansed, the surgeon protrudes the testicle with his left hand so as to make the overlying tissues tense, and divides them from the external abdominal ring, prolonging his incision as required, so as to ensure free and easy drainage. In cases where the skin is involved by a growth, ulcerated by a hernia testis, or invaded by tubercle, two elliptical incisions should be made, well wide of the disease, and meeting above and below. The first incision having exposed the cord above, this is defined, and the scrotal tunics are quickly shelled off with the right hand, while the testis is still further protruded with the left.[‡] The spermatic cord is now isolated as high as may be needful, the inguinal canal being carefully opened upon a director, if this is necessary to get above the disease. An aneurysm-needle, threaded with a double ligature of aseptic silk or stout chromic gut, is passed through

Fig. 191.[†]



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[*] On these subjects I may refer my readers to chapter xii. p. 477 of *Diseases of the Male Organs of Generation.*

[†] In malignant disease the incision should be carried up much higher into the groin and the cord tied close to the internal ring. To prevent a hernia the layers should be sutured according to the directions given at p. 202.

[‡] There is often an adhesion below, between the testis and the fundus of the scrotum (Fig. 191). This represents, according to some, the remains of the mesorchium.

the cord, the loop of the ligature cut, the needle withdrawn, and, the cord having been tied in two halves, the ends of one ligature are cut short, while those of the other are tied round the whole cord to ensure that no vessel escapes. The ends of this also are then cut short. The ligatures being thus embedded in the cord substance, there is no risk of their slipping, and if they be tied as tightly as possible (by looping the ligatures round two pairs of scissors or forceps), there is no danger of after-suffering. Other methods consist in securing the vessels alone, singly by torsion, or by chromic gut, or by fixing the cord in the upper angle of the wound with a clamp. The mode of ligature above given is much more speedy and also, I am certain, perfectly efficient. Securing each vessel is tedious, as it is needful to make sure of every one, even when they are not enlarged, a condition not infrequent in growths. If any of the arteries are left unsecured, dangerous bleeding, when the cord retracts upwards, calling for laying open of the canal, is very probable.

The cord, having been secured, is severed at least an inch above the disease, and the mass removed. The wound is then examined in the case of a soft, rapid growth, and where a tubercular testis has threatened to fungate, any suspicious skin must be clipped away, and a sharp spoon freely used.

A few scrotal vessels, notably one in the septum, may require securing. The wound is then closed with carbolised silk and horsehair, pains being taken to meet the tendency of the scrotal edges to invert.

Every precaution should be taken during and after the operation to promote rapid healing, especially in hospital practice. Patients who have to submit to castration are often reduced in health, and are thus liable to erysipelas, and in cases which become septic a low form of peritonitis is very likely to follow, especially if the canal has been opened up; moreover, septic thrombosis may easily follow a wound made in a region so abounding in lymphatics and loose cellular tissue.

ORCHIDOPEXY.

The following account of this operation is extracted from that given in *Diseases of the Male Organs of Generation.*

One or two preliminary questions arise here: What is the value of the retained or ectopic testicle? At what age ought the operation to be performed? These may be answered together. It will be seen by reference to the account given at page 45 (*Dis. of Male Org. of Gen.*) of the condition of the retained or ectopic testicle, if nothing be done, that the following are certain: (*a*) That such a testicle ultimately becomes, and usually before adult life is reached, physiologically useless; (*b*) That, as some of the cases I have given show, during the early years of life the testicle, though ill-developed, may be capable under more natural surroundings of becoming a useful organ; (*c*) That the period in which the testicle passes from a probably useful into a useless state must be an uncertain one, varying with the attacks of inflammation, &c. Most French surgeons have advised deferring the operation until the age of about 16, as up till this time a retained testicle may still descend. While this is true, I should strongly advocate resort to operation at an earlier date, a step which I have taken in the cases given below, on the following grounds: It must always b quite uncertain at what date structural changes marring the efficien of a testicle have set in. These must depend on the number of recurre inflammatory attacks, and children are certainly not exempt from the Again, in cases complicated with a hernia, the longer an operation deferred the more difficult will it be to ensure a radical cure. Moreove a condition of this kind, interfering as it may do with activity and enjoyment of life, schooling, apprenticeship, &c., should be put right as soon as possible. Finally, if the testicle's growth and development are to be furthered by the transplantation, and this is one great object of the operation, it is surely more probable that this end will be secured by bringing the testicle into its natural home before puberty—that important epoch—and its consequent sexual changes have set in. I should prefer operating between the ages of 8 and 9, though in the case of the children of the poor, where time is of great importance, I should consider it quite justifiable to operate earlier, especially if there has been any attack of pain, or if a troublesome hernia co-exists. Before the age of 2 or 3 years the small size of the parts, their fragility as far as holding sutures go, and the difficulty of maintaining asepsis are contra-indications to operative interference.

The following account will be found to apply both to the case of a child and that of an adolescent.

The bowels having been well moved for a day or two before, the parts duly cleansed and shaved if needful, an incision is made with the external ring for its centre, as retention near this spot is the condition most frequently calling for operation. This incision can be prolonged upwards and downwards if needful, but needless weakening of the abdominal wall can often be avoided by dragging up or down the two angles of the wound with retractors, invaginating the scrotum, &c.

In cases of inguinal retention the testicle is often subcutaneous, and is reached after division of the external oblique and intercolumnar fascia.

The following points have now to be inquired into:—What is the arrangement of the peritonæum? Is the serous sac which surrounds the testicle continuous with and common to the peritonæal cavity or separated from it by obliteration of the funicular portion in part? The sac around the testicle or any prolongation upwards having been opened, the above question is settled. If the peritonæal process is open, it should be divided circularly with great care, so as to avoid the cord, a little above the testicle. While the lowest part, thus left, is fashioned by a few catgut sutures into a tunica vaginalis, the upper part is freed most carefully from its surroundings as high as the internal ring, where it is secured by ligature or torsion, as the surgeon prefers. If the peritonæal canal is found to be closed in the inguinal canal and above the testicle, it must be treated by the steps already given after its closed lower end has been found and the process freed. Care must always be taken to extirpate this process as far as possible and to close it thoroughly, as by this precaution an important obstruction is placed in the way of the testicle's remounting. Is a hernia present? If so, any adhesions to the testicle being separated, this is returned in the usual way. But the presence of a hernia must always, especially where there is any doubt as to the condition of the testicle, incline the surgeon to sacrifice the testicle and his hope of transplantation, and thus make sure of radically curing the far more important trouble. Will it be possible to bring the testicle satisfactorily down into the scrotum? How best will it be retained there? All adhesions should be divided as freely as possible, the position of the cord being first defined. Where the cord seems at first short, careful, sustained, downward traction will often be of much assistance. When the testicle has been coaxed or pushed through the external ring, a bed must be prepared for it, if needful, with the finger in the scrotum. This is then invaginated with the tip of a finger, and the tissues thus presented sutured to the testicle with aseptic silk or chromic gut. The suture should be of silk in cases where the operation is performed at or after puberty. In earlier cases chromic gut will perhaps suffice, though I prefer well-carbolised fine silk. The suture should always be passed boldly, dipped well into the connective tissue of the invaginated fundus scroti on the one hand, and into the tunica albuginea of the testicle or the tail of the epididymis on the other. I prefer this method of invagination to that of passing the suture through the scrotum from without inwards, then next into the tunica albuginea, then out of the scrotum again, and tying the ends over a pad of gauze. Finally, when the testis is *in situ* the cord should be sutured to the pillars of the ring with fine catgut or silk, the vas and the spermatic artery also, if possible, being made out and inspected. Then this ring should be carefully closed with fine silk, its pillars being first defined.

The tendency of the testicle again to enter the vaginal canal is often so persistent and so marked, that not one of the following precautions should be omitted, viz.:—(1) Obliteration of the funiculo-vaginal process. (2) Separation as far as possible of any adhesions which prevent the transplantation of the testicle. This should include division of any bands of the cremaster, or of anything which can keep back the testicle, the cord alone being respected. (3) Suture of the testicle to the fundus scroti. (4) Suture of the cord to the pillars of the external ring, and closure of this opening. (5) In three cases, to overcome the tension, Mr. Wood carefully dissected through the connective tissue attaching the testicle to the globus major, so far down as to enable him to turn the testicle upside down with the lowest part of the epididymis still attached to the testis. By this means the length of the testicle (an inch and a half) was gained, and the testicle lay without further strain topsy-turvy in the scrotum, the cord and the epididymis being above it. This step, aided by antiseptic details and proper drainage, was followed by perfect success.

After the testicle has thus been fixed the wound is carefully dried, all bleeding arrested, the wound closed, and the dressings applied.

Writing in 1901, Mr. Jacobson wishes to state that his later experience tends to show that this operation is of very little value. Supposing a scrotum to be present, everything depends on whether the cord is long enough to allow of the testis resting in the scrotum without any tension. As a rule, to which there are very few exceptions, this is not the case. Out of seven cases he has had only one permanent and real success.

A boy, æt. 11, with iliac retention on the right side, had been refused admission to the Royal Navy. The friends accepted all risk. The scrotum was developed. At the operation a very unusual condition was found, viz., a loop of lax constituents of the

cord where they met at the internal ring. The testis was easily brought down and secured in the scrotum, the layers of the abdominal wall being sutured much as in the radical cure of hernia. Two years later the boy was serving on the North American station.

On the other hand, Mr. Jacobson has known a testis, fixed in the scrotum, reascend a year and a half later, during the pyrexia of an attack of influenza.

VASECTOMY.

The division or removal of portions of the vasa deferentia has been largely practised during recent years as an alternative to castration for certain cases of hypertrophy of the prostate (*vide* p. 479). The chief arguments that have been advanced in favour of vasectomy are:—(1) That its effect on the prostate is the same as that of castration; (2) That the operation is much less severe than castration, and therefore better borne by the type of patients who need such measures; (3) That it meets the rooted objection to loss of the testicles that many men have, even when advanced in years.

On the other hand, although some brilliant successes have been recorded, the mortality, as shown by Wood's figures (*loc. supra cit.* p. 480), amounts to 6·7 per cent., not very much less than the present mortality of castration for enlarged prostate. Again, the improvement is usually not so great as after castration, and it is not nearly so certain: Wood's figures show that some improvement took place in only 67 per cent. as against 90 per cent. improved after castration. Finally, there is evidence that relapse takes place in some of the cases in which this operation is performed, and Freyer (*Lancet*, vol. i. 1900, p. 155), goes so far as to say that "In a very considerable proportion of the cases there has been no permanent benefit from this operation." This might be expected from the very nature of the operation, which cannot possibly have anything like the same effect on the sexual organs generally that castration must have.

This method of treatment, then, is to be recommended only when a patient, whose condition is suitable for treatment by castration (*vide* p. 480), has refused the more certain method.

Operation.—An anæsthetic having been given and the skin prepared, a small incision, one-half to one inch in length, according to the amount of subcutaneous fat present, is made over the spermatic cord opposite the pubic crest. By pressing the cord up into the wound with the thumb and index finger of the left hand, the vas can be quickly found and isolated up by means of an aneurysm-needle or blunt hook passed beneath it. The vas is now divided, and its ends either twisted with Spencer Wells's forceps, as recommended by Reginald Harrison (*Lancet*, vol. i. 1900, p. 1275), or ligatured with or without resection of a small portion. Both vasa should be divided at the one operation.

CHAPTER XIV.

OPERATIONS ON THE ANUS AND RECTUM.

FISTULA.—HÆMORRHOIDS.—FISSURE.—PROLAPSUS.—EXCISION OF THE RECTUM.—IMPERFORATE ANUS.—ATRESIA ANI.—IMPERFECTLY DEVELOPED RECTUM.

FISTULA.

Varieties.—As these have a very practical bearing upon the operation they must be alluded to here.

i. *Complete.* ii. *Blind External.*—Here an external opening only exists, though in a considerable number of cases the internal opening is overlooked. iii. *Blind Internal.*—An opening through the mucous membrane is here the only one. This is the rarest, but an important variety, as, if overlooked, it is certain to be troublesome.

A discoloured dot or patch of skin sometimes marks the place where an external opening may occur. Mr. Lund (*Hunt. Lect.*, p. 88) relates a case in which a very chronic and slowly advancing blind internal fistula had excited, by its extreme end, just enough inflammatory thickening of the skin as to imitate a keloid growth, for which it was at first mistaken.

Situation of Openings.—Both of these are usually within an inch, more often half an inch, of the anus. The internal one may be detected as a slight depression or papilla by the finger, or by the speculum, or, in obscurer cases, by Mr. Lund's method (p. 89).

Horsehoe Fistulæ.—Here an external opening on either side communicates with a single internal one, often at the back. This is an uncommon, but an important variety, for if it is found necessary to cut through the sphincter ani at both sides, some loss of power is very likely to ensue. This risk should be explained to the patient, and the shallower fistula should be scraped, while the deeper is freely incised. If it is necessary to cut the sphincter on both sides, the knife should be employed on two distinct occasions, time being given for the first to heal.*

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* Mr. Cripps (*Dis. of Rectum and Anus*, p. 165) shows that if, in women, the sphincter is cut thorough anteriorly where it decussates with the sphincter vaginæ, incontinence of fæces is very likely to take place.

Multiple Fistulæ.—This condition should always cause a suspicion of stricture, or extensive ulceration—*e.g.*, syphilitic, &c.

Fistula with Tuberculosis.—Where a fistula presents an external opening with undermined, livid edges, where the tubera ischii stand out prominently from emaciated nates, and where the hair of the part is long and curled, tuberculosis is always to be suspected, even if no history of cough or hæmoptysis is given.

Question of Operating on Phthisical Patients.—While each case must be decided by itself, the following remarks may be useful:—

Where the phthisis is advanced, the cough incessant, the fistula multiple or branched, an operation is out of the question. On the other hand, where the physical signs are little marked, night sweats slight or absent, where the fistula interferes with the patient taking the all-essential exercise, where the power of repair is good, an operation is indicated.

In cases intermediate between the above, each one must be decided upon its own merits.

Before operating the surgeon should remember that repair is here often sluggish, the mental condition much depressed. He should do all he can to improve the general condition before and after the operation. And if this can be performed in sunny weather, or, better still, at the seaside, so that the patient can soon have fresh air in the recumbent position, so much the better.

Operation.—For a few days before the operation the diet should be restricted, and the bowels emptied by aperients. The hour of the operation should be so arranged as to give time for the enema, which should be given, to come away. The patient being under an anæsthetic, and either on his side with the knees well flexed, or in lithotomy position, the surgeon introduces lightly a fine Brodie's probe. In the case of a complete fistula, the internal opening being hit off (p. 487), the point of the probe is felt for by the finger and hooked out of the anus. If, after careful examination, the surgeon is satisfied that no internal opening exists, he makes one by finding the exact spot at which the coats of the bowel are most thinned, and thrusting the point of the probe through here.

In the case of a blind internal fistula the internal opening must be found with a speculum, and the probe, curved, passed from this so as to project beneath the skin. In every case the whole length of the sinus between skin and bowel must be completely laid open. When this has been done, very careful examination is made for other sinuses by the introduction of the probe, and by pressure with the finger, which squeezes out any discharge, and feels for indurated tracks. Wherever these run they must, if possible, be laid open. I have already (p. 487) alluded to the question of dividing the sphincter in two places. If any sinus seems to run dangerously high, hæmorrhage may be avoided by dividing it with a small écraseur, or, more gradually, by the elastic ligature. Every attempt, however, should be made, with the aid of a good light and forcible dilatation of the sphincter, to lay open every sinus with bistoury or scissors, extra care being taken, the higher the incision has to be carried, to arrest all bleeding with carbolised silk ligatures or by leaving on Spencer Wells's forceps.

While the sinuses are being followed up, any old gristly tissue must be completely removed, all pyogenic or granulation tissue entirely scraped out, and every ill-nourished flap and tag of undermined skin cut away.

If any troublesome piles co-exist they should be tied and cut away at the same time (p. 490) or crushed (p. 492).

As a dressing I prefer a little twisted salicylic wool dusted with iodoform, as I find this adapts itself more easily to the different wounds. Less and less should be re-applied, daily, as granulations become established. After the first week little more is needed than daily cleansing of the wound with a camel's-hair brush, or a dossil of cotton-wool on a Playfair's probe. If the edges of the wound close too soon they should be separated with a probe from time to time, or any redundancy may be painted with cocaine and snipped away.*

Finally, no operation better exemplifies the truth of Mr. Curling's saying, that the surgeon should be his own dresser.

Immediate Union of Fistulæ.—Mr. Reeves recommended this treatment some years ago (*Brit. Med. Journ.*, vol. i. 1887, p. 917). It certainly has the advantage of often shortening the treatment greatly,† and preventing loss of sphincter power, but at the risk of two dangers: (1) Sepsis. (2) The part within the bowel is sometimes difficult to suture satisfactorily, and may persist as a sinus later. The method may be tried in simple cases which do not extend far into the bowel.

Operation.—The anus having been well dilated, the fistula is laid open, thoroughly scraped out, any skin or mucous membrane which is unhealthy or which will get between the edges of the wound must be snipped away, the bleeding stopped, the wound well irrigated with lot. hydr. perch. (1 in 4000) and well dried out. It is then united in its whole extent by sutures of salmon-gut or sterilised silk. These are left in for a week or ten days. During this time the bowels, which have been previously (daily) thoroughly emptied and cleansed with naphthol, must not act. A glycerine or oil enema must prevent any passage of scybala and straining at the time of the first relief.

HÆMORRHOIDS.

Indications.

1. Continuance of hæmorrhage or discharge, and persistent liability to descent of piles in spite of judicious treatment.
2. Absence of albuminuria, diabetes, and hepatic (probably, cardiac) disease.
3. Amenability on the part of the patient.

In Mr. Cripps's words (*loc. supra cit.*, p. 99): "The smallness of the risk should not lull the surgeon into a sense of absolute security, and he should spare no effort in ascertaining the general constitutional condition of his patients. . . . . The amount of risk, slight as it is, should be clearly laid before the patient or his friends. If a man is to have some grave operation performed, such as the removal of a cancer or the amputation of a limb, both he and his friends are well aware of the risk involved, and are accordingly prepared. It is, therefore, in the smaller operations, regarded by the surgeon and public as free from danger, that a fatality, when it does occur, becomes so tragic from being unexpected."

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* Another excellent dressing, later on, is tr. benz. co. or dilute nitric acid lotion 10 minims to 1 oz. The latter needs changing every four hours.

† It is right to add that the tediousness of the after-treatment is often due to the patient refusing to lie up, or to inefficient attention on the part of the surgeon himself.

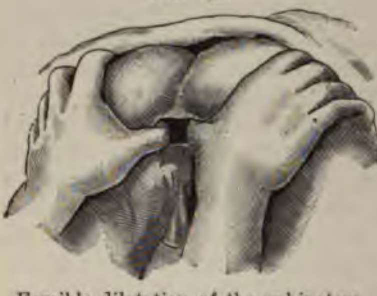
Operations.

Ligature.—Cautery.—Crushing.—Acid.—Whitehead's Operation.—Thelwell Thomas's Operation.

i. **Ligature.**—I have placed this first, from a strong belief that, if properly used, it is, on the whole, the best method and the one most generally applicable. Here, as elsewhere, that surgeon will have the best results who has thoroughly familiarised himself with the details of one operation. The following appears to me to be a fair way of putting the merits of ligature and the other operations:

1. In my opinion the ligature is more generally suited to all cases. Again, it can be more easily applied to piles high up than can the cautery. 2. No special instruments are needed. 3. A ligature applied is done once for all; the cautery may have to be reapplied more than once if bleeding follows when the clamp is unscrewed. 4. The risk of bleeding is less, and hence this method is especially advantageous in anæmic patients, and in those for whom it might be difficult to immediately obtain surgical aid (Allingham). 5. The ligature is free from the objections to the cautery in private practice—viz., the smell, and, unless a Paquelin's cautery is at hand, the cumbersome apparatus otherwise rarely used.

FIG. 192.



Forcible dilatation of the sphincters. (Esmarch and Köwalzig).

Operation.—The preparatory treatment is that given at p. 488. The patient being on his left side, or in the lithotomy position, the anus should always be dilated. This may be done by introducing, and then separating laterally, the two thumbs (Fig. 192), the pressure being steadily maintained so as not to rupture the mucous membrane; after a few minutes a sensation of yielding rather than of tearing is perceived. Another method is to introduce a large bi- or multi-valve vaginal speculum, and to withdraw this expanded.* When the sphincters are thoroughly dilated the piles which lie lowest according to the patient's position† are drawn down with a vulsellum or tenaculum-forceps, and the surgeon, with blunt-pointed scissors, curved on the flat, cuts a groove around the lower two-thirds of the pile, which is thus separated for this distance from the sub-mucous and muscular coats. In the lower piles this groove should commence in the sulcus, which marks the junction of skin and mucous membrane close to the anus. The object of this groove is twofold. It forms a bed in which the ligature can be sunk tightly, and, above all, it leaves a very small pedicle of tissues to be strangled. The groove, moreover, can be cut without risk of hæmorrhage, as, however large the pile, its vessels enter it from above, running into its upper part just beneath the mucous membrane. The surgeon then ties round each pile, which is now still further dragged down, a ligature of well carbolised silk, the strength of which he has previously tested. Sinking this into the groove, he tightens it up so as to embed his ligatures firmly, without cutting through the pedicle. About two-thirds of the pile are then cut away, enough being always left to ensure a safe hold for the ligature. In Allingham's *Diseases of the Rectum*, p. 146, the following most important practical point is insisted on. When the piles are separated from the bowel preparatory to applying the ligature, it is essential that the base to be ligatured should be as narrow as is consistent with safe securing of its blood-supply. For if many piles have to be tied, and their bases are left large and broad, when tied up they draw the mucous membrane together, and cause great narrowing of the rectum. In such a case it is almost impossible to introduce the finger, without force, beyond the parts tied. In other words, islets of untied mucous membrane, as wide as possible, should always be left between the tied piles. This will secure less pain, easier action of the bowels, and less risk of contraction. After every internal pile has been carefully treated in this way, the external ones are partly clipped away, care being taken not to encroach upon the junction of skin and mucous membrane, and not to remove subcutaneous tissue for fear of subsequent contraction. If any bleeding points still persist, they should now be tied. The ligatures are all cut short, and lastly the stumps of the piles, after thorough irrigation with lot. hydr. perch. (1–4000) and rubbing in of iodoform powder, are returned. A morphia suppository is then introduced, strips of iodoform gauze wrung out of carbolic-acid lotion applied, and firm pressure made with a T-bandage and the aid of a pad of salicylic wool, carbolised tow, or "tarred cotton."

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* Eversion of the rectal mucous membrane by a finger in the vagina will often be most helpful in bringing piles within reach.

† This prevents the other hæmorrhoids being obscured with blood. Mr. Allingham advises that the smallest piles should be taken first, as there is a danger of these being overlooked and thus leading to a recurrence of the disorder.

ii. **Clamp and Cautery.**—This method has been perfected by Mr. H. Smith.* The preparatory treatment and position of the patient are those already given. The piles having been sufficiently protruded, and the anus forcibly dilated, they are drawn well down, one by one, with vulsellum forceps, and enclosed within the blades of the clamp, which is screwed tightly up. With scissors curved on the flat the pile is then so cut away as to leave a sufficient stump. This is then carefully and thoroughly seared down with a Paquelin's cautery, carefully kept at a dull red heat. If the iron sticks at any moment, owing to its cooling down, it should not be pulled away, but loosened by heating it a little. The clamp-screw is then slightly relaxed, and if any bleeding takes place it is at once tightened up, and the cautery reapplied. Every care must be taken to burn down the stump thoroughly at the first attempt, for if this fail, and oozing take place, it is not easy to stop the bleeding, from the tendency of the stump to slip through the slackened clamp. The piles having been successively dealt with in this way, the stumps are smeared with iodoform ointment and pushed well up with a finger coated with the same.

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* Mr. H. Smith (*Syst. of Surg.*, vol. ii. p. 840) had almost entirely discarded the use of scissors, removing the clamped piles with heated cauteries instead. Three of these are figured.

This method is thought by some to secure more rapid healing with less pain than the ligature. This, however true of the old methods, does not hold good when the piles are freely detached and the ligature tied with the precautions already given. The clamp is less easily manipulated in the rectum, it is a special instrument not always at hand, and the smell entailed by the cautery is most unpleasant. The surgeon who uses it must be extremely careful to keep his seared surfaces as small as possible, and by no means to entrench upon the skin. It is well known how slowly, how painfully, and with what a tendency to contraction burns heal.

iii. **Crushing.**—This method was prominently brought forward by Mr. Pollock (*Lancet*, vol. ii. 1880, p. 1 *et passim*) as less painful than the ligature, and as leaving a mere thin and superficial fringe of dead tissue, instead of the slough of the clamp and cautery. The anus being fully dilated, each pile is drawn down with a vulsellum, and firmly crushed for a period varying from one to three minutes. The projecting part of the pile should then be cut away. The best instrument is Mr. H. W. Allingham's "screw-crusher." This has enormous power, and possesses the advantage that it may be introduced into the bowel. Skin should not be crushed, an incision being always made, when needful, at the junction of skin and mucous membrane. The upper part of the instrument should rest within the rectum, so as not to drag on the mucous membrane. Mr. Allingham (*Dis. of Rectum*, p. 133) has found that pain after this method is rather less than after the ligature, and that recovery is somewhat more rapid. Œdema of the parts outside may be very marked; "contraction so as to require dilatation by bougie or finger occurred about as frequently as after any other method of operation upon piles, but far less than after the cure by the actual cautery." Hæmorrhage is extremely rare after careful use of the screw-crusher. If it occurs, it is best arrested by leaving on Spencer Wells's forceps. Mr. Allingham gives the following advice as to suitable and unsuitable cases: "It may be used when the piles are small and not numerous, say three in number. It may be applied to remove a pile or two when operating for fistula. Partial prolapse of the mucous membrane falls within the same category. I should not advise its use in cases of very large vascular piles, in which, from excessive hæmorrhage, the blood is poor and non-coagulable. In cases of anæmia as a result of hæmorrhage, in which recurrent or secondary hæmorrhage would probably cost the patient his life, this method is decidedly dangerous. It should not be used to remove inflamed piles. It is not wise to crush piles when the patient is at a distance from skilled assistance, for fear of hæmorrhage coming on."

iv. **Acid.**—This method, formerly much over-rated, should be reserved for that rare variety of pile, sessile, perinæal, usually, in position, and with a florid, granular surface. Vaseline having been applied around, the surface of the pile is dried, and carefully rubbed over with fresh, strong nitric acid, or acid mercury nitrate, this being thoroughly applied with a glass rod or pointed bit of wood. The acid should be rubbed in and in, the pile being kept dry and the acid not allowed to run. Every atom of the florid surface must be converted into a brownish, shaggy slough.

v. **Whitehead's** [*] **Operation of Excision of the whole "Pile-bearing" Area.**—This extensive operation is intended to bring about a radical cure, its object being not only to remove any existing piles, but also all the mucous membrane in the lowest part of the rectum, which is the seat of piles, owing to the tendency of its veins to become dilated. Though Mr. Whitehead has performed this operation in three hundred cases without a fatal result or any drawback, I cannot but consider it needlessly extensive and severe, especially in patients of middle life, and in a part which cannot always be kept sweet, even with the aid of iodoform. The operation by ligature, or by clamp and cautery, carefully performed, gives most excellent results, and in answer to Mr. Whitehead's argument, that as long as this diseased area is left to reproduce piles over and over again, no permanent cure can be expected, I may say that I have always found that, after one of the above operations has been properly carried out, the patient can easily prevent any recurrence by attention to common-sense details in daily life. Finally, I know of one case, in a young, healthy patient, fatal from blood-poisoning.

The following criticism (Allingham, *Dis. of Rectum*, p. 139) appears to me soundly based: "Mr. Whitehead terms his operation simple. Simple it may be, but difficult to perform, for with the anus rugose and elastic as it is, even after dilatation of the sphincters, it is not at all easy to separate the mucous membrane from the skin. The time required for the operation is an objection; this process takes on an average at least thirty minutes, where a skilled surgeon can operate with the ligature in less than five minutes. The hæmorrhage by this method far exceeds the amount lost when the ligature is used, and this is of great importance in those patients who have already lost much blood from their piles. . . . . Two or three days after the operation the parts not infrequently become swollen, and the mucous membrane then tears through the ligatures and retracts away from the skin. This leaves a large granulating surface which may occupy the entire circumference of the bowel, and cause troublesome contraction.

Operation.—The sphincters having been thoroughly dilated, and the hæmorrhoidal area of mucous membrane made to prolapse, the line of junction of skin and mucous membrane[†] is looked for, and the latter divided along it all round the anus with blunt-pointed scissors. The cut mucous membrane is then dissected up, with forceps and scissors, from off the external and (in part) the internal sphincter, till the whole of the pile-producing area of mucous membrane can be pulled down and drawn outside the anus. It is then cut away, bit by bit,[‡] transversely at its still attached upper border, each portion when divided being at once attached to the cut skin with carbolised silk sutures. In this way the diseased area is removed as a complete ring of mucous membrane. Each bleeding-point is secured by torsion or forcipressure. Iodoform is dusted over the wound. The sutures are allowed to come away of themselves.

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[*] *Brit. Med. Journ.*, Feb. 26, 1887.

[†] The "white line" of Mr. Hilton (*Rest and Pain*, p. 289, Figs. 51 and 52).

[‡] So as to diminish the hæmorrhage, which would otherwise be free at this stage.

vi. **Thelwell Thomas's Operation** (*Brit. Med. Journ.*, Nov. 26, 1898). —Mr. Thelwell Thomas has devised the following operation. The great advantages that he claims for it are—(1) that primary union is obtained, and so convalescence is more rapid; (2) that reactionary and secondary hæmorrhage are prevented.

Operation.—The sphincter having been stretched, "a large pile is seized by artery forceps, and its base clamped, the clamp being always put on in the long axis of the bowel. I have most frequently used Smith's clamp, but a dressing forceps with a catch will do quite as well.* The bulk of the pile is cut away, leaving a small stump standing off the clamp. The treatment of this is the essential feature of the operation. A piece of catgut, not too fine, about a foot in length, with a domestic needle at each end, is used for a suture. Commencing at the top end of the stump one needle is passed through, and the catgut follows until there is one half the length of the suture on each side, with its own needle attached. A reef knot is tied on the stump, and the needle, which is on the right side, is brought over to the left and passed through the stump lower down and back again to the right. The needle which is on the left is taken over to the right and passed through the stump back to the left immediately adjoining the previous one. A reef knot is again made, and so on to the end of the stump, making five or six crossings to the inch. This method of suture brings the cut edges of the mucous membrane tightly together, and its advantage over a simple continuous suture is apparent, each cross and knot making each segment independent of the next. The clamp is slackened, and occasionally, though rarely, it may be necessary to tie a small vessel at the top end of the stump, particularly if a cross-acting clamp is used. All the internal piles are thus treated."

Mr. Thomas has performed forty-five operations in this way with extremely satisfactory results. The bowels were opened on the fifth day, and full diet was given on the eighth day. No pain was complained of, and none had any hæmorrhage or inflammation. The average stay in hospital of the forty-five cases was 8·8 days.†

Causes of Failure and Trouble after Operations for Hæmorrhoids:

1. Hæmorrhage.—This will be extremely rare if the ligature method be carefully employed. The conditions under which this complication may occur are cases of long-standing piles or prolapsus in weakly subjects, cases where the tissues are very friable, where the patient insists on getting out of bed to pass water, or where he strains very much at the first action of the bowels. If the surgeon be called upon to meet it, the best means is to apply Spencer Wells's forceps, and to leave these *in situ;* in a severer case, or where the above are not available, Mr. Allingham's plan of plugging should be used (*Dis. of the Rectum*, p. 67). Through a conical sponge a silk ligature is threaded from apex to base. The sponge, well dusted with iodoform and steel sulphate, is pushed four or five inches into the bowel, and the whole of the space below it is plugged with aseptic gauze. The

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* Later Mr. Thomas says that he has found Doyen's broad ligament clamp (small size) superior to all others.

† This is certainly too short. The patient should be kept recumbent for three weeks.

sponge is now pulled *down* by the two ends of the ligature while the gauze is pushed *up*. The plug should be left in as long as possible, the patient being kept under the influence of laudanum. It is well to pass a large catheter through the sponge before this is inserted, to allow of escape of flatus. 2. Tedious ulceration.—This is usually due to the patients getting up too soon. They should remain in bed a week or ten days, and then be content to pass another ten or fourteen days upon the sofa. 3. Septic troubles. 4. Contraction.—This is usually stated to be only likely to occur when, in cutting away piles, especially external ones, the junction of skin and mucous membrane is trenched upon. But the fact is that where many piles have had to be removed, where islands of mucous membrane (p. 491) have not been left between them, the ulcerated surfaces thus tending to coalesce, contraction of the surface as it cicatrises is very likely indeed to lead to some narrowing of the lumen of the gut. This must always be prevented by the early passage of the finger of the surgeon in charge, this being repeated daily if any tendency to contraction is found. Where a stricture, generally about one inch and a half from the anus, has been allowed to form, the patient's condition is a most vexatious one, though it will always yield to the use of bougies, aided, if need be, by nicking of the contraction. 5. Abscess. 6. Fistula. 7. Bubo. 8. Pelvic suppuration. These four are given by Mr. Allingham (*loc. supra cit.*, p. 163) as sequelæ in unhealthy patients, especially if the healing has been accompanied by prolonged suppuration. The antiseptics of the present day should prevent this.

FISSURE.*—ULCER.

The operative treatment of these is so simple and so eminently successful, that it should be resorted to early.

Operation by Incision.—The preparatory treatment and the position of the patient are the same as those already given. The division of the ulcer may be performed in one or two ways—(*a*) From without; (*b*) from within the rectum.

(*a*) *From without.*—Here the ulcer, being fully exposed with a speculum—and the one which bears Mr. Hilton's name, with a movable valve, will be found the best—a small sharp-pointed bistoury is inserted a little beneath the base of the ulcer, and its point made to protrude in the bowel above it; the parts are then divided from without inwards through the centre of the ulcer.

(*b*) *From within.*—Here, the ulcer being also exposed, either by stretching the parts with two fingers or with a speculum, a straight blunt-pointed bistoury is drawn across the whole of the sore, through its centre, going deep enough to divide about a third of the fibres of the external sphincter. Mr. Curling (*Dis. of the Rectum*, p. 12) has drawn attention to an important point here, and that is, that the fibres of the muscle at the extremity of the ulcer near the verge of the anus should be divided rather more freely than those above, so as to avoid any ridge or shelf on which the fæces would lodge.

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* This condition, often called a fissure, nearly always amounts to an ulcer when it is carefully examined and the parts unfolded.

There is usually no hæmorrhage to speak of, and the whole operation is so simple that it may be performed after an injection of cocaine, or with nitrous oxide gas, unless anything else—*e.g.*, attention to piles—is required. I prefer, however, to operate with ether or the A.C.E. mixture.

Of the two methods, I generally make use of the first, following Mr. Hilton. I consider it the more certain, and have never known anything like incontinence in the nine cases in which I have used it. The second is rather the slighter operation, and also gives good results.

The position of these usually club-shaped ulcers is posterior. If one is met with anteriorly in a woman, it would be wiser to try the application of acids, or the actual cautery. See footnote, p. 487.

The surgeon must be careful, when examining into the amount of repair a week or two later, not to do any damage if a speculum is employed.

Operation by Dilatation of the Sphincter.—This is not only rough but uncertain, and should not be employed.

PROLAPSUS.

Indications.—Failure of previous treatments. Large size and long duration of the prolapsus. Altered condition of the mucous membrane—viz., thickening or ulcers, the latter giving rise to hæmorrhage. Incontinence of fæces, especially when fluid, or of flatus.

Operations.

Acid.—Cautery.—Excision.

1. **Acid.**—Of these I prefer the acid nitrate of mercury. This method is especially applicable to the obstinate cases of prolapsus in children, where the bowel is constantly down. Though, if the application is made properly, only a sensation of burning is complained of, an anæsthetic should always be given. The patient being in the lithotomy position, or on one side, the prolapsus is carefully dried of all mucus, and the surgeon rubs in the acid with the aid of a glass rod or pointed pieces of wood, the adjacent skin being protected with vaseline.

Care must be taken not to rub in the acid too long or too vigorously, for if the inflammatory process set up affects deeply the sub-mucous tissue, a most troublesome stricture may readily result.

It is well to warn the patients that a second application may be required in severe cases.

The after-treatment is that given below.

2. **Cautery.**—In severer cases, or where the acid has failed, the following will be found efficient. The position of the patient is as for pile operations, but it is best to apply the cautery to the bowel *in situ*, though this may be used when the bowel is prolapsed.

Thus, the patient being in lithotomy position, and a duckbill-speculum introduced and held in contact with the anterior wall of the rectum, the blade of a thermo-cautery is drawn edgeways along the lower three or four inches of the opposite surface of the gut. The speculum being shifted, the anterior and lateral aspects are similarly treated in severe cases.

Care must be taken not to go *through* the mucous membrane, or septic mischief and sloughing may be set up in the cellular tissue beneath.

3. **Excision.**—In severe cases, in adults, when other methods have failed, this method should be resorted to, but even with the improvements of the present day there must always be a difficulty in keeping wounds here aseptic. Either portions of mucous membrane only, or, in very severe and intractable cases, the whole prolapse, may be removed.

i. **Excision of mucous membrane.**

The patient being in lithotomy position, the prolapsus reduced, and the parts exposed by a duckbill-speculum, two or more elliptical pieces of mucous membrane are removed by pinching them up with vulsellum-forceps and cutting them away with a very sharp scalpel or scissors. Any bleeding vessels are then tied with chromic gut, and the edges of the wound united by horsehair or fishing-gut sutures. Iodoform is then carefully dusted on, and the parts smeared with an ointment of the same.

The insertion of sutures has the advantage of preventing hæmorrhage, and hastening the cure. If the sutures have to be removed, especial care will be needed not to break down the union with the speculum. The wounds must be irrigated frequently with a solution of hydr. perch (1 in 4000), and a small Higginson's syringe.

ii. **Complete removal of the prolapse.**

Although a more certain cure, this method is much more severe than those already described, and owing to the risk of the operation, should be reserved for cases in which other methods of treatment have failed, the prolapse has become irreducible, or when gangrene threatens.

The operation essentially consists of amputation of the prolapsed bowel, with suture of the divided edges at the margin of the anus.

It must be remembered, however, that a pouch of peritonæum may be present in front between the layers of the prolapsed bowel, and that, in certain cases, a herniated loop of intestine may lie within this pouch. Owing to the vascularity of the parts considerable hæmorrhage may occur, and, with a view to controlling this, several operators have advised constriction of the base of the prolapse, either by means of specially devised clamps, or by an elastic ligature, applied above transfixing pins, before commencing its removal. The objection to this is, however, the possibility of damage to a knuckle of small intestine lying in a prolapsed peritonæal pouch. Moreover, the hæmorrhage may be satisfactorily dealt with by dividing only small portions of tissue at a time and applying catgut ligatures to the vessels in each portion as they are divided.

The details of the operation have been varied by many surgeons, one of the best methods being undoubtedly that of Mickulicz, which is described as follows by Cumston, of Boston (*Ann. of Surg.*, March, 1900), in a paper containing much valuable information:

"Mickulicz first cuts through the outer intestinal tube in its anterior circumference by cutting the tissues, layer after layer, catching up each bleeding vessel as it appears, and ligating it with fine catgut. As soon as the peritonæal pouch has been opened, its interior is examined for the presence of small intestine. The peritonæal cavity is then closed by a running suture. The anterior aspect of the internal intestinal tube is cut through, little by little, until it is opened, and then both intestinal tubes are united by deep silk sutures along the entire line of the incision.

"The posterior circumference of the prolapse is treated in absolutely the same way, both intestinal ends being united by means of silk sutures, and thus the resection is completed."

After-treatment.—After any operation for prolapsus, the patient must rest for three weeks on the sofa to allow of firm consolidation and cicatrisation taking place. Light diet alone should be allowed at first, and the bowels should, at first, be allowed to act only every three days, and, if possible, while the patient is on his side.

EXCISION OF THE RECTUM.

Partial excision would be usually a more correct term in the great majority of cases, but as by the sacral route, first brought before the notice of the profession by Kraske, the rectum has been removed up to the sigmoid flexure, I retain this heading. Under it the following operations will be considered: (i) **Excision from the perinæum.** (ii) **Kraske's operation and its modifications.** (iii) **Excision by the vagina.** (iv) **Excision by abdominal section.** (v) **Excision by the abdomino-perinæal method.**

Indications. Suitable cases. 1. Malignant disease of anus—*e.g.*, papillomata or a neglected fistula, or condylomata becoming epitheliomatous. 2. Rarely non-malignant stricture and ulceration may be treated in this way instead of by dilatation, but only in cases where extensive ulceration exists with multiple points of stenosis, and the use of the bougie is found to be ineffectual. 3. Malignant disease of the rectum. Of the points which have to be now considered, the extent of the disease is the most important. A growth that is limited to the rectum, at whatever part it may be situated, and however high it may extend along the course of the bowel, may be removed by one of the methods about to be described. Extension beyond the rectum to surrounding parts, as shown by fixity of the growth to the sacrum on the one hand, or to the bladder, vagina, or uterus on the other, constitutes a contra-indication to any attempt at a radical operation. The amount of fixity may, however, be most difficult to estimate.

The administration of ether or A.C.E. may help here as well as in deciding the extent of the disease. The parts where it is most difficult and important to estimate the mobility are the neighbourhood of the prostate, urethra, and the neck of the uterus. Mr. Cripps thinks that though the bowel in contact with the prostate may be diseased, it is a long while before the prostate itself becomes infected; in women, on the contrary, when the disease is on the anterior part of the bowel, the vagina and uterus quickly become implicated. The recto-vaginal septum, if involved in its lower part, may be cut away, but the patient will be liable to find fæces getting into the vagina, especially when the bowels are loose. The condition of the glands, sacral, iliac, and inguinal, will, of course, be examined, and the possibility of deposits in the liver remembered.

Glandular infiltration is said by several to occur late in rectal carcinoma. This, at first sight a point which may favour operation, is counterbalanced by the well-known fact that rectal carcinoma is frequently insidious, and that thus, by the time it has pronounced its existence, it is already in an advanced stage.

Finally, the age of the patient, this being not judged of by years alone, the condition of the kidneys and other viscera, whether the general condition and reparative powers are sufficiently good to meet the calls of what may be a very severe operation, must all be taken into careful consideration.

Much information bearing on the value of excision of the rectum will come out if we institute a **comparison between Excision of the Rectum and Colotomy.** The chief points calling for attention are—(i) The mortality of the operation. (ii) The duration of life after it. (iii) The amount of comfort given by it.

(i) *The Mortality of the Operation.*—In making a comparison on this head between colotomy and excision of the rectum, one important point must always be remembered—*i.e.*, that the latter operation is never performed under those unfavourable conditions of obstruction which, owing to the operation being often deferred till too late, render the mortality of colotomy such a high one. Turning to the mortality of excision by itself, without comparison with any other operation, we find that McCosh, in 1892 (*New York Med. Journ.*, Sept. 3), collected 439 cases with 84 deaths, a mortality of 19·1 per cent. Later, Kraske (*Ann. of Surg.*, vol. ii. 1897, p. 380) gives a mortality of 9·8 per cent., or 5 deaths in 51 cases operated upon during the years 1890—1897, and Paul (*Lancet*, vol. ii. 1897, p. 78) publishes a series of 28 cases with 4 deaths, *i.e.*, a mortality of 14·2 per cent.

In this, as in every other comparatively novel and important operation, a very large number of unsuccessful cases will remain unpublished, whilst nearly every successful case is reported at once. The real death-rate, therefore, when the facility with which shock, hæmorrhage, cellulitis, peritonitis may occur in a part which cannot be kept absolutely aseptic, and in patients no longer young and the subjects of rectal cancer, is fairly estimated, lies probably between 15 and 20 per cent. Nor, when we consider how limited man's capacity for bearing grave operations remains, however much we have advanced in surgery, is it at all probable that the death-rate will fall much below 20 per cent., if all cases operated on are honestly reported. When we consider the mortality of inguinal colotomy for rectal cancer, excluding the cases where colotomy is performed under the most unfavourable circumstances of obstruction, in other words "the too late cases," the mortality will be distinctly less, varying from under 5 to under 10, accordingly as the operation is performed by operators of especial experience or otherwise. Here, too, the value of statistics is greatly impaired by the tendency to publish only successes. But there can be no doubt whatever that colotomy in cases uncomplicated by obstruction is most distinctly a safer operation than excision of the rectum from the perinæum, and, *à fortiori*, than the severer methods.

(ii) *Duration of Life.*—With regard to this point, I think a larger number of cases will show that if the surgeon decides to advise, and the patient is willing to run the risk of, the more serious operation, the prolongation of life will be greater here than after colotomy, if the cases are wisely selected. I think that the above is borne out by the results of the statistics which we have. It is rare for patients after colotomy for carcinoma to survive more than one year and a half. Making due allowance for the advanced date at which cases of rectal cancer too often come under treatment, for the fact that excision will usually be performed in selected cases, and that thus colotomy will be reserved for those less favourable, I think the published cases of excision show a greater prolongation of life.

Volkmann (*Sammlung Klin. Vorträge*, May 13, 1878) claimed three complete cures and several cases of very late recurrence—viz., one after 6 years, one after 5, and one after 3. One case died of carcinoma of the liver 8 years after operation without local recurrence, and one case remained well 11 years after the removal of a large mass reaching high up; in this case recurrence occurred twice in the scar, and was removed. Czerny's experience is also very good. Two of his cases had survived the operation over 4 years, one 3 years and 4 months; three others were well after intervals of at least 2 years (Henck, *Arch. f. Klin. Chir.*, Bd. xxix. Hft. 3). Mr. Ball (*Dis. of the Rectum and Anus*, 2nd ed. p. 364) has had one patient alive and well 9 years and another 6 years after operation. Mr. Cripps (*loc. supra cit.*) has had one case free from recurrence 12 years, two 6 years, one 5 years, two 4 years, one 3 years after operation. More recently, Kraske (*loc. supra cit.*), in the series of fifty-one cases above referred to, states that sixteen patients died from intercurrent disease, without signs of recurrence or metastasis, at times varying from 1¼ to 5 years after the operation, and fifteen patients are alive and free from recurrence ¾ of a year to 8½ years after the operation. Keen (*Ther. Gaz.*, April 1897) gives the results of twelve cases which survived the operation; four had passed the 4-year limit, and two others had nearly reached it, without recurrence.

(iii) *Amount of Comfort Afforded.*—After this operation, as after excision of the larynx, a distinction must be drawn between mere survival and what deserves the name of recovery. The amount of comfort enjoyed by the patient will depend on: (1) The amount of contraction that takes place. (2) How far he has control over his motions. The patient should always be warned about these sequelæ. If he does not keep under observation, and contraction follows, I consider his case will compare most unfavourably with that after a well-performed colotomy, and may even be as bad as that of a patient with advanced rectal cancer. (1) Where the whole circumference of the bowel has been removed, a matter referred to below (p. 505), it is obvious that there must be a great risk of contraction in the scar tissue which replaces the mucous membrane. This contraction forms a most serious difficulty in the after-treatment, and is liable to lead to most unsatisfactory results. The more the connective tissue around the bowel is interfered with, the more profuse the suppuration and the longer the healing, the more marked will the contraction be. Colotomy has been required for it, as occurred in a case under my care, where excision of the rectum had been performed elsewhere. The above risk may be obviated, no doubt, by drawing down the bowel and suturing it to the skin; but this step (p. 505) is not often feasible, especially in men, and if sutures are inserted they cut through quickly (*vide infra*). The severed end of the bowel is drawn considerably downwards during the process of healing. This renders it easier for the patients to pass a bougie from time to time, the need of which must be firmly impressed upon them. Another means of securing the patency of the bowel is by wearing a vulcanite tube, as recommended by Mr. Allingham. These are three or four inches long, with one end conical, and with the other ending in a broadish flange to prevent its slipping into the bowel, and also to enable it to be stitched to a bandage which keeps it in place. Patients begin to wear it about a fortnight after the operation, and, save for taking it out when the bowels act, retain it constantly for some months, some having to wear it for the rest of their lives.

(2) As to the power of retaining fæces, incontinence is always present at first, but control is usually regained after a time, save where the motions are loose. Mr. Cripps (*loc. supra cit.*) states that incontinence was present in only seven out of thirty-six cases which he collected. Torsion, after the advice of Gersuny (*vide infra*), as a preventive when the entire circumference of the bowel and the sphincters have been removed, has proved satisfactory in some cases (p. 512).

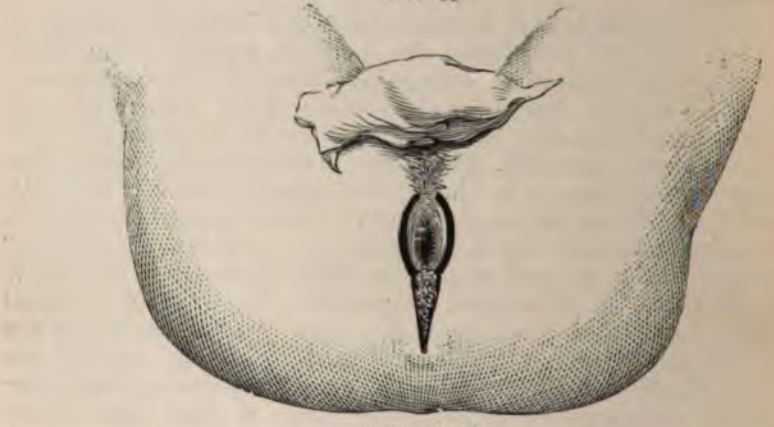
Operation.

The preliminary treatment is most important. The patient should be kept in bed for several days before the operation, and the strength and general condition improved as much as possible by the administration of plenty of light, easily digested and nutritious food. The rectum and large intestine should also be efficiently emptied by means of mild purgatives and daily enemata. If the growth causes marked obstruction to the passage of fæces or to the efficient administration of enemata, lavage of the bowel, by means of a long rectal tube passed through the stricture, should be made use of. In order to promote rapid healing and prevent suppuration, as much as possible, every effort should be made to render the bowel as little septic as possible. To this end intestinal antiseptics, such as resorcin, salol, &c., may be administered by the mouth, and weak antiseptic solutions used for lavage and for the enemata. Where a rapid, soft growth, quickly ulcerating, has given rise to a foul discharge, Dr. E. H. Taylor (*Ann. of Surg.*, vol. i. 1897, p. 385) recommends curetting as a preliminary measure, in order to bring about a sweeter condition of the growth and surrounding parts. He makes use of a flushing spoon for this purpose, and finds that the hæmorrhage is "trivial, and soon ceases." On the other hand, Kraske considers that this should be done only exceptionally, as it is not without danger.

With regard to the question of performing colotomy before the excision of the growth, the opinions of authorities differ. Kraske only makes use of it when the growth is causing obstruction, and so prevents efficient emptying of the bowel before operation. He then makes the artificial anus in the transverse colon, as being less likely to interfere with the subsequent operation and more easy to close later. On the other hand, M. Quénu, quoted by Taylor (*loc. supra cit.*), always performs a preliminary inguinal colotomy, usually about twelve days before the main operation. Keen (*Journ. Amer. Med. Assoc.*, 1898) also is in favour of a colotomy, and, moreover, makes the artificial anus a permanent one, by closing the upper end of the divided rectum after removal of the growth. The chief objections to a preliminary colotomy are that it causes loss of valuable time without a compensating advantage, since, with careful preliminary evacuation of the bowel, the operation and the after-course are quite satisfactory without it; that it saps the patient's strength and so diminishes his power of standing the more severe operation, and that, by fixing the bowel above, it may interfere with its mobility, thus preventing it from being efficiently pulled down at the second operation. It would seem, therefore, that the wisest course lies in reserving colotomy for those cases in which there is either declared or threatened obstruction, preventing the proper evacuation of the bowel before the growth is excised.

The most suitable operation in a given case will vary according to the position and extent of the growth. For a growth involving the lowest two inches of the rectum the operation by a perinæal incision will usually suffice; for more extensive growths, Kraske's method or one of the modifications of that operation, will generally be necessary. Finally, for a few rare cases in which the growth is situated very high up in the rectum, the combined perinæal and abdominal method will be required.

FIG. 193.



(Allingham.)

Perinæal Excision of Rectum in its Entire Circumference.—The patient is placed in lithotomy position, and the surgeon makes an oval incision into both ischio-rectal fossæ, around the bowel, then prolongs this oval incision backwards so as to reach the coccyx (Fig. 193).

This backward prolongation is much needed in order to give additional room for meeting hæmorrhage,* and for providing drainage later on. The fingers, aided if needful by the knife or blunt dissector, separate the bowel at the sides and posteriorly as high as the levator ani; the hæmorrhage is usually not severe, and can be readily arrested by pressure-forceps, sponges pushed into the incision, and by operating as rapidly as is consistent with safety. Taylor (*loc. supra cit.*) recommends that the posterior incision should be made first, and then the lateral ones in the following manner, in order to better preserve the sphincteric apparatus, and thus prevent incontinence afterwards. "Begin by a median posterior incision behind the anal margin and extend it backwards in the middle line over the coccyx. Then, starting from the tip of this, follow the median raphé forwards, splitting the posterior part of the external sphincter and separating the levatores ani. On introducing the index finger into the wound, the rectum is easily cleared on its posterior and lateral aspects. Strong, blunt-pointed scissors are now taken, one blade is placed in the wound just behind the anus, and, in the interval between the rectum and the levator ani, the other blade rests upon the skin. The bridge of tissue between the blades is now cut, and a similar section made upon the opposite side."

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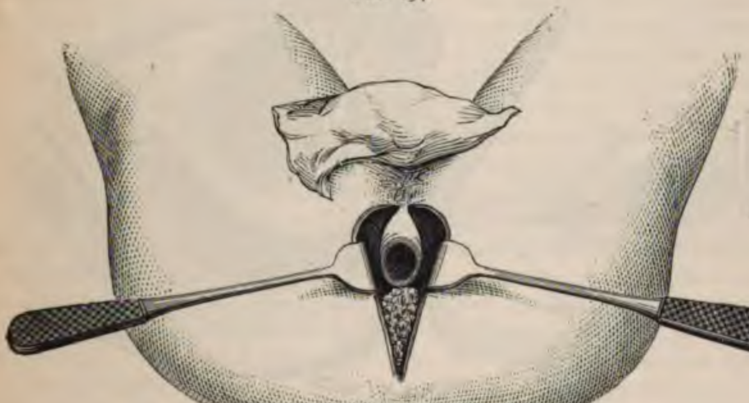
* If this incision has to be carried as high up as three or four inches, the hæmorrhage will be free, as the superior hæmorrhoidal artery here divides into two terminal branches. A sufficient incision, well opened out with large retractors, will admit of easily dealing with this vessel. Another method is to begin by a free posterior incision, made by guiding a curved sharp bistoury well above the disease in the posterior wall, bringing out the point at the tip of the coccyx, and then cutting all the intervening tissues into the bowel. This exposes well the limits of the growth, but causes more bleeding. If the first method is made use of, the bowel must be laid open subsequently, to investigate the upper limits of the disease.

FIG. 194.



(Allingham.)

The adoption of this plan will be found to materially facilitate the separation of the bowel, in addition to saving the levator ani muscles.

The separation of the bowel in front varies with the sex of the patient. In a male, a full-sized metal sound having been passed into the bladder and kept well hooked up under the pubes,* the surgeon carefully dissects, partly with his finger and partly with scissors, between the bowel and urethra and prostate. These parts are naturally adherent, and this dissection must be carefully conducted, as any opening into the bladder or urethra will much increase the shock. If the left index be kept in the rectum and the thumb just outside it, they will serve to pull the bowel as it is freed away from the urinary tract, while the operator is at the same time kept informed how near to the bowel he is cutting (Fig. 195). In the case of a woman the surgeon's left index, or the finger of an assistant in the vagina, will give the best warning of his knife or scissors (the latter, long and blunt-pointed, are preferable) getting too near the vaginal mucous membrane.* If this be encroached upon, it must be removed without hesitation, in the hope that the cloaca thus formed will be much diminished by contraction, or that it may be closed subsequently. If the disease has extended up the recto-vaginal septum, the peritonæum must be looked out for, and the greatest care taken not to open this cavity at the upper part of the dissection. If this should occur, an aseptic sponge must be kept over the opening. The levator ani being carefully cut through, the rectum, now separated everywhere save above, is dragged down by an assistant or by the operator with his left hand. While this tension is kept up, the surgeon with his finger, aided by scissors, frees the bowel sufficiently above the disease to admit of dividing it safely. Frequent examination of the interior of the bowel should be made at this stage to tell when the upper limit of the disease has been reached. The rectum should be divided at least an inch above this point. Before the bowel is cut away, the upper end should be secured with a vulsellum, for fear that it may retract and carry any still bleeding points out of reach.

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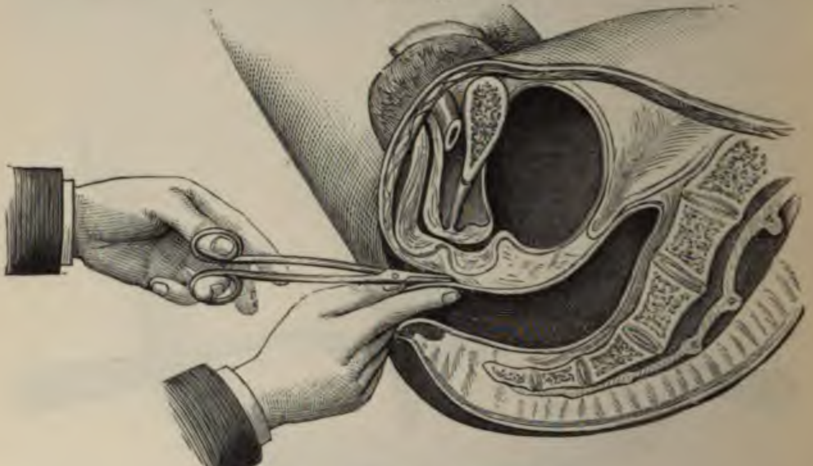
* Prof. Macleod advises that, if the disease is low down, it matters little whether the bladder is full or empty; if a higher portion has to be dealt with, as Dupuytren showed, the urine should b[illegible]ed, so as to raise the recto-vesical pouch.

FIG. 195.



(Allingham.)

When the bowel has been safely isolated above the disease, it must be divided with scissors. These are greatly to be preferred to the écraseur, as they give a much more cleanly cut surface, and one therefore less liable to slough, and they furthermore avoid the risk which is inseparable from the use of the écraseur—viz., its gradually encroaching, as it is tightened, more and more closely upon the diseased area.

One objection to the division of the rectum with a Paquelin's cautery is, as remarked by Mr. Cripps, that the use of any form of cautery during the operation makes it exceedingly difficult to distinguish between the hard nodules of burnt tissue and portions of the disease which may be left behind.

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* Subsequent sloughing here is not unlikely.

The bowel having been removed, bleeding points* are most carefully looked for, and the wound, thoroughly irrigated and dusted over with iodoform.†

If the peritonæum has been injured and the opening is too large for suturing, either a drainage-tube packed around with gauze (Bardenhauer), or a tampon of gauze, must be made use of.

Mr. Cripps considers that any attempt to bring down the cut edges of the rectum, and to stitch them *in situ* around the anus, is perfectly useless, as the **sutures** are certain to cut their way out, and harmful, as likely to prevent the escape of discharges. As this entails the very serious risk of septicæmia, the advantage which suturing the bowel would give, if it were safe, of preventing subsequent contraction (p. 500) has been put aside.

On the other hand, Volkmann, Czerny (*loc. supra cit.*) and others have recommended the use of sutures so as to hasten healing and obviate the tendency to stricture. If they are employed, they must be passed as advised by Ball, not only through skin and bowel, but also deeply through the surrounding pelvic structures as well; drainage-tubes should also be inserted here and there between the sutures. Superficial sutures are then put in as well, so as to further diminish the strain. If these precautions are taken, if no fæcal contamination of the wound has occurred, if antiseptic precautions have been taken throughout, and if the wound has been rendered thoroughly dry and bloodless, the employment of sutures deserves a trial in appropriate cases.

Mr. Bidwell (*Brit. Med. Journ.*, Oct. 21, 1899) recommends the following plan to enable the edges of the wound to be brought together. Two transverse incisions about two inches long are made on each side of the perinæal incision. The flaps of skin so formed are then dissected up and attached to the cut edge of the rectum by means of silkworm gut sutures. As a rule, this can be carried out without undue tension, but should there be any, a longitudinal incision in the posterior surface of the rectum will enable the union to be effected.

If the growth reaches the skin of the anus the inguinal lymphatic glands must be carefully examined, and, if found enlarged, they must be removed either at once or at a second operation. If the bowel cannot be sutured in the position of the anus, Taylor (*loc. supra cit.*) recommends that "it be drawn backwards in the middle line between the levatores ani and a subcoccygeal anus formed. The wound in front is then closed by deep sutures. As Mr. Ball points out, they have the great advantage of not leaving recesses about the rectum in which serum might collect and decompose. These deep sutures should, of course, include the levatores ani; our object being to reconstruct a sphincteric apparatus."

Question of partial removal.—If any of the mucous membrane, even a mere strip, can be *safely* left, the amount of subsequent contraction will be less; but here, as in all other operations for malignant disease, every consideration must give way to the chief object, that of extirpating the growth.

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* If the patient's strength fail towards the close of the operation, no time should be lost in tying the vessels, but each bleeding point should be secured with Spencer Wells's forceps; these are removed in twenty-four or thirty-six hours.

† Throughout the operation the wound should be well syringed with a solution mercury perchloride (1 in 4000). This should be used very hot if there is troublesome oozing.

Partial operations should be reserved only for cases where the disease is very localised in amount, and admits of extirpation, together with a very wide margin of bowel. Where the disease implicates one-half of the bowel, even if apparently not disseminated in the mucous membrane, the whole circumference should be removed. Mr. Allingham thus condemns partial operations: "The partial removal of the circumference of the bowel is, in my opinion, most unsatisfactory. In all the cases in which I have removed only part of the wall there has been either a return of the disease in the rectum, or in the glands in the groin, or in some internal organ, mostly the liver."

If the surgeon decide on a partial operation, he must be prepared for some increased difficulty, owing to the diminished room for working, and meeting the hæmorrhage. Perhaps only one semilunar incision around the anus will be required.

Kraske's Operation and its Modifications (Fig. 199).—Kraske, of Freiburg (*Arch. f. Klin. Chir.*, Bd. xxxiii. S. 563), introduced this route as best adapted for those cases which, in Volkmann's words, are situated too high for the perinæal route and are too low and too fixed to admit of removal by abdominal section. It will be understood by all that this is an operation of great severity, and only justifiable when, as compared with colotomy, the risks on the one hand, and the advantage on the other, of attempting a radical cure, and, at all events, affording a greater prolongation of life (p. 499), have been fairly put before the patient or the friends. Again, it is only a surgeon who has had large operating experience who should undertake, and only patients who have sufficient reparative power who should be submitted to, any of these operations of excision of the rectum, more particularly to this and the ones that follow. For at least four days before the operation the patient should be prepared by aperients and enemata and a wisely restricted fluid diet.[*] The parts having been previously shaved and cleansed, the latter process is repeated when the patient is passing under the anæsthetic, and the bowel cleansed as high up as possible by irrigation with lot. hydr. perch. (1 in 5000), and with swabs of iodoform gauze on long forceps. Dr. Kelsey insists upon this, as it may be of the greatest help to be able to introduce the finger into the bowel during the operation: "Exactly in proportion to the thoroughness of this disinfection, and to the care with which the wound is kept clean during every stage of the operation will be the mortality." A small tampon of iodoform gauze may be left in the rectum, but too large a mass obscures palpation of the diseased part from the incision. The patient may be on his right side as recommended by Kraske, or on his face, or, again, in the lithotomy position, according to the convenience of the operator. If the thighs are kept well flexed, and a sand pillow is placed under the lumbar spine, it will be found that the lithotomy position is very suitable, the intestines in this position falling away from the recto-vesical pouch, the separation of the peritonæum being thus facilitated, and moreover the light coming from above, the deep wound will be well illuminated, and the whole of its extent well under the eye of the operator. Whatever be the position, the pelvis should be elevated, so as to diminish hæmorrhage. An incision is then made in the middle line from the posterior edge of the anus to the centre of the sacrum, the knife being carried down to the bone at once.

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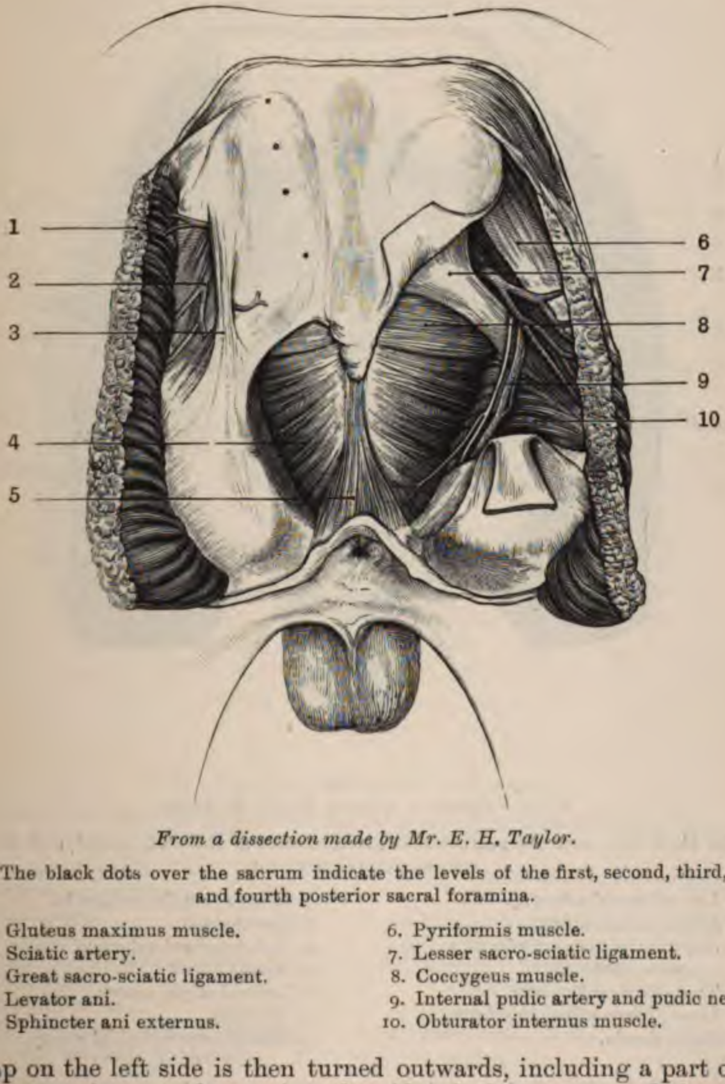
[*] Dr. C. B. Kelsey (*New York Med. Journ.*, vol. ii. 1895, p. 457) advises that a dose of morphine and bismuth should be given on the evening before, and repeated a few hours before the operation. The paper is an excellent one, full of practical hints from which I have borrowed largely.

FIG. 196.



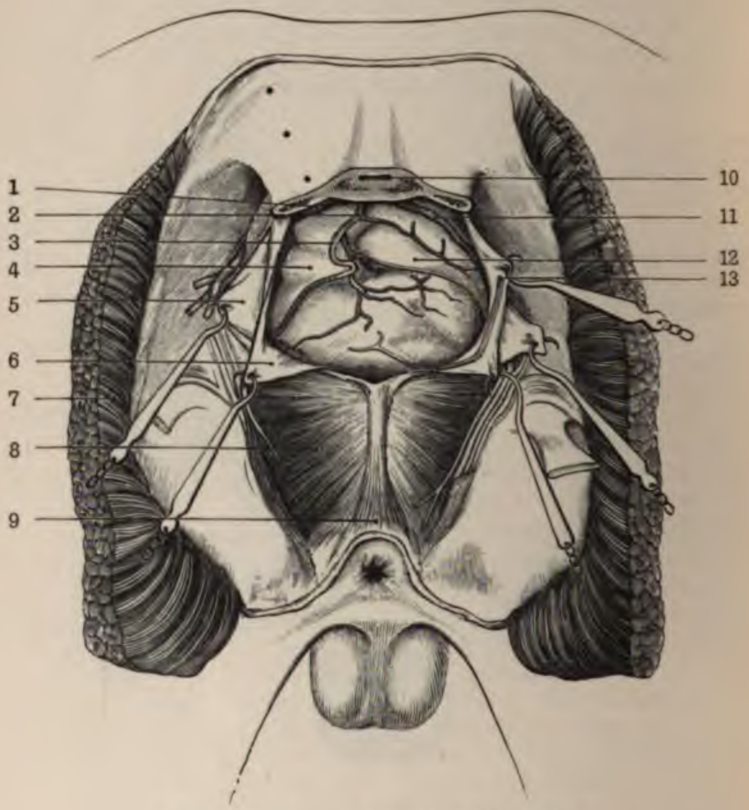
From a dissection made by Mr. E. H. Taylor.

The black dots over the sacrum indicate the levels of the first, second, third, and fourth posterior sacral foramina.

1. Gluteus maximus muscle.
2. Sciatic artery.
3. Great sacro-sciatic ligament.
4. Levator ani.
5. Sphincter ani externus.
6. Pyriformis muscle.
7. Lesser sacro-sciatic ligament.
8. Coccygeus muscle.
9. Internal pudic artery and pudic nerve.
10. Obturator internus muscle.

A flap on the left side is then turned outwards, including a part of the gluteus maximus, and exposing the side of the sacrum and the sacro-sciatic ligaments. These last must be divided and detached from both sides of the coccyx and the left side of the sacrum, together with the coccygeus, part of the left pyriformis and, if the anal region is to be removed, the sphincter and levator ani. With a periostæal elevator passed under the sacrum the soft parts are now detached from the hollow of this bone, including the sacra media vessels and a venous plexus, thus avoiding troublesome bleeding. The surgeon must now decide how much bone requires removal. Reference to the lines of bone-section indicated in Fig. 199 will show the extent to which bone is removed in Kraske's original operation, and in some of the chief modifications of this. No hard-and-fast lines can, however, be laid down, since the amount of room required and therefore the amount of bone which must be removed, must depend entirely upon the extent of the growth and the size of the outlet of the pelvis. Kraske (*loc.*

FIG. 197.



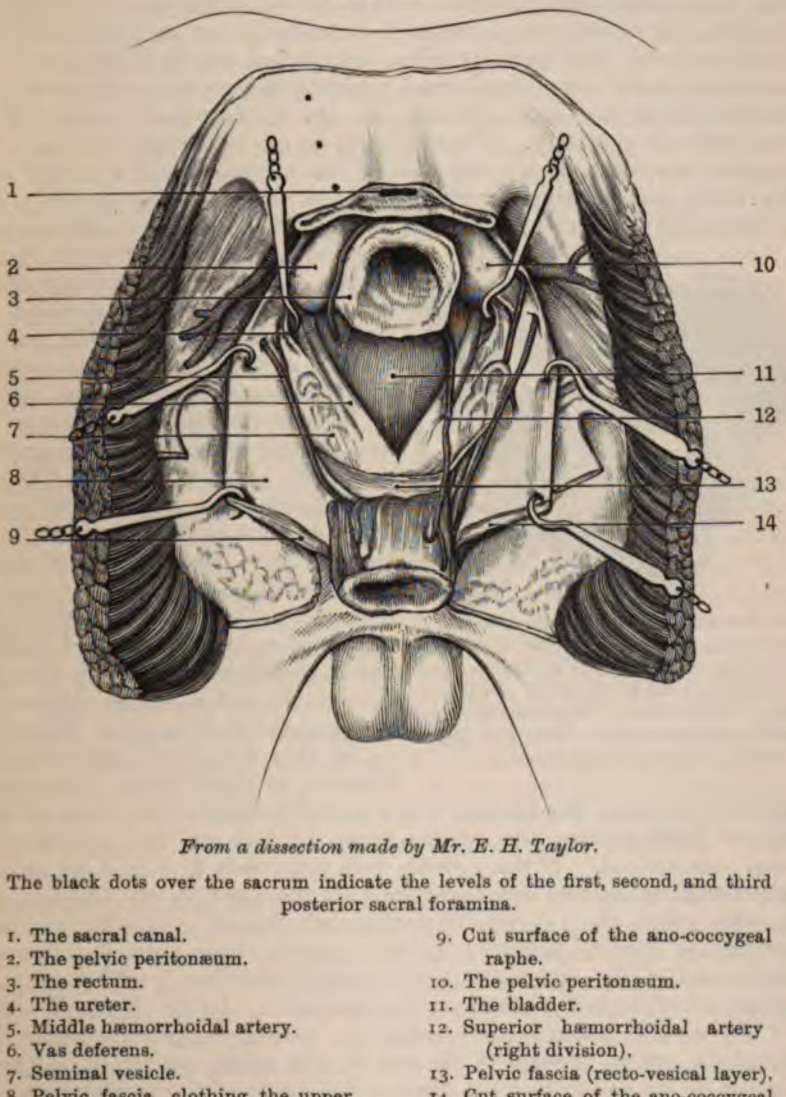
From a dissection made by Mr. E. H. Taylor

The black dots over the sacrum indicate the levels of the first, second, and third posterior sacral foramina.

1. Lateral sacral artery.
2. Middle sacral artery.
3. Superior hæmorrhoidal artery (left main division).
4. The pelvic peritonæum.
5. Lesser sacro-sciatic ligament.
6. Pelvic fascia.
7. Gluteus maximus muscle.
8. Levator ani.
9. Sphincter ani externus.
10. Sacral canal.
11. Lateral sacral artery.
12. Rectum.
13. Middle hæmorrhoidal artery.

supra cit. p. 499) does not now recommend removal of any bone beyond the coccyx except when this is necessary in order to get sufficient room. Senn (*Philad. Med. Journ.*, Sept. 30, 1899) has come to the conclusion that resection of the sacrum is not only needless, but absolutely harmful, and maintains that removal of the coccyx only will *always* be sufficient. The coccyx should therefore be removed in the first instance; if then the amount of space obtained is found t be insufficient, resection of the sacrum must be resorted to. Tayl

FIG. 198.



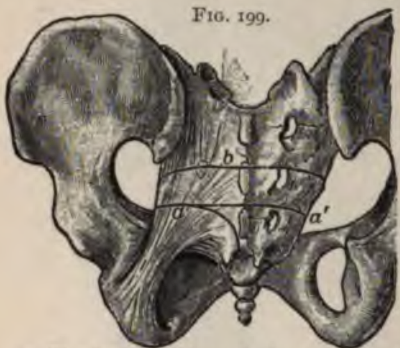
From a dissection made by Mr. E. H. Taylor.

The black dots over the sacrum indicate the levels of the first, second, and third posterior sacral foramina.

1. The sacral canal.
2. The pelvic peritonæum.
3. The rectum.
4. The ureter.
5. Middle hæmorrhoidal artery.
6. Vas deferens.
7. Seminal vesicle.
8. Pelvic fascia, clothing the upper surface of the levator ani.
9. Cut surface of the ano-coccygeal raphe.
10. The pelvic peritonæum.
11. The bladder.
12. Superior hæmorrhoidal artery (right division).
13. Pelvic fascia (recto-vesical layer).
14. Cut surface of the ano-coccygeal raphé.

(*loc. supra cit.*) advocates temporary sacral resection, as first practised by Heinecke, and later by Rehn and Rydygier, chiefly on the ground that this prevents the loss of posterior support of the levatores ani which results from permanent resection. The chief objections to this plan are, that it does not give so much room, that the bone-flaps are liable to necrosis, and that the formation of a sacral anus is not possible. In suitable cases, however, such as the successful one which Taylor describes, the method has much to recommend it, but, as a general rule, it will be found that sacral resection as carried out by Kraske will be as efficient as the more complicated methods, and, moreover, is more rapid in performance and more suitable for the formation of a sacral anus should this be necessary. The soft parts being vigorously retracted the surgeon cuts through the left side of the sacrum along a curved line (Fig. 199) commencing on the left edge, at the level of the third posterior sacral foramen, and running inwards and downwards through the fourth foramen to the left corner of the sacrum. By cutting along this line the anterior division of the third sacral nerve will not be divided nor the sacral canal opened. The bleeding up to this time, which is largely venous, is best met by firm sponge or finger pressure; much time will be lost in attempting to seize the bleeding points in the usual way. As soon as the bone is out, the vessels may be closed by forcipressure or, where needful, by underrunning. The hæmorrhage comes chiefly from the lateral and middle sacral, the hæmorrhoidal arteries, the bone itself, and a venous plexus on both aspects of the sacrum. The pelvis is, in this way, freely opened, and from six to eight inches of the bowel may be removed. The tissues, down to and including the levatores ani, are now divided along the median raphé behind, and the separation of bowel commenced. If the growth does not reach to within an inch of the external sphincter, this, together with the anus, is left intact; if, on the other hand, there is any suspicion that the external sphincter and anal region may be involved by the growth, these must be removed. Unless matted by extension of the disease, the bowel will readily be shelled out of its bed, posteriorly and laterally. In Dr. Kelsey's words (*loc. supra cit.*), "the finger cannot be passed completely under and around the gut on account of its size at this point, nor can it be drawn down at all on account of the firm attachments of the peritonæum and the meso-rectum. Any forcible attempt to drag it down at this stage is attended by great risk of rupture and consequent soiling of the wound, and all that should be attempted is gentle isolation on each side by separating it from its loose attachments with the finger, and discovering by touch the extent of the disease to be removed, which can generally be easily done by palpating the tube as it lies in the wound."

FIG. 199.



a. The incision, through the sacrum, of Kraske's (p. 507). *a*, *a'*. That of Bardenhauer, who takes away the whole lower part of the bone as far as the third sacral foramina. *b*. Incision of v. Volkmann and Rose which passes through the bone at a higher level still. (Esmarch and Kowalzig.)

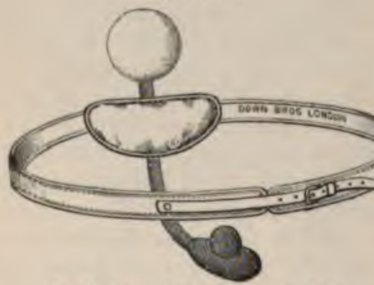
The next step in the procedure consists in the division of the bowel below the growth. This section should be made at least one inch below the lower margin of the disease, and at a greater distance if there is any doubt as to the extent to which the bowel is infiltrated with growth. Before the section is made the bowel may be either encircled just below the growth with a strong silk ligature, or, as recommended by Kraske, sutures may be passed through the upper cut surface, or again the bowel may be clamped with forceps. The patient is now brought into the lithotomy position (if this has not been done already) and the separation of the bowel continued. This is carried out, as already described in the perinæal operation, partly by blunt dissection and partly by means of scissors. In the male, a full-sized sound must be passed, and every care taken in separating the rectum from the prostate and bladder, while, in the female, the finger of an assistant will serve as a guide and help to prevent perforation of the posterior wall of the vagina at this stage. Soon the peritonæal reflection will be reached on the anterior wall; if this is found to lie well above the upper extremity of the growth it may be possible to separate it upwards with the finger to the desired extent, and thus avoid opening the peritonæal sac altogether. Should it be found, however, that the growth extends above the level of the peritonæal reflection, it will not be possible to separate the peritonæum, and the fold should then be at once opened freely. The bowel is now held from coming down only by the meso-rectum. This, together with the pre-sacral cellular tissue and contained glands, is now carefully separated from the concavity of the sacrum to the desired extent, gentle traction being made on the bowel while this is being done. When sufficient of the bowel has been freed and brought down in this way, it is clamped one inch to one inch and a half above the upper margin of the growth and divided, the surrounding wound being at this stage carefully packed with gauze in order to prevent contamination if any fæcal matter should escape. The meso-rectum and pre-sacral cellular tissue is now divided at the same level, vessels being clamped as they are cut. As soon as the growth is removed the upper stump must be wrapped up in a piece of iodoform gauze while the wound is attended to. All bleeding must be arrested, vessels ligatured, and the wound wiped over with pledgets of gauze wrung out of hot perchloride or formalin lotion (1 in 2000).

Treatment of the Peritonæal Wound.—If the opening into the peritonæum be quite a small one this may be ligatured or sutured, but should a large aperture be present Kraske advises that it be simply plugged with a tampon of iodoform gauze and no attempt at suture made, since plugging is undoubtedly safer, whilst suturing may be attended with much difficulty and occupy considerable time.

Treatment of the Ends of the Bowel.—The methods advocated by different surgeons as regards this most important step vary very considerably, and at the present time it cannot be said that the question is by any means settled. Kraske (*loc. cit.*, p. 499) after having abandoned it for some time, on account of repeated failures, has finally returned to his original plan of immediate direct suture, finding that complete or almost complete union can be obtained if the bowels are kept constipated for eight to ten days after the operation. The anteric and lateral portions are united by two tiers of sutures, one passing through the whole thickness of the bowel, and the other through mucous membrane only. The posterior part is closed by inverting sutures not involving the mucous surface. Where the growth does not reach very low down this method may be carried out, but if the external sphincter has to be sacrificed, a sacral anus may be formed by fixing the upper divided end of the bowel to the posterior angle of the wound as recommended by Hochenegg (*Brit. Med. Journ.*, vol. i. 1900, p. 1031). Paul, who gives a series of twenty-eight cases with four deaths (*Lancet*, vol. ii. 1897, p. 78), has abandoned approximation of the divided ends if more than three inches of the rectum have been removed, and uses one of his tubes (Fig. 39) in the following manner, as described in a former paper.

The rectum is first thoroughly freed by opening the peritonæal sac, and dividing as much of the meso-rectum as is necessary. "When plenty of the bowel has been drawn down, the rent in the peritonæum may be loosely closed with a few fine sutures, and a large glass intestinal drainage tube, plugged with wool, is inserted into the bowel and ligatured above the growths. If the intestine is loaded with fæces th tube had better be introduce below the stricture and forced up* to the detriment of the specimen, as it is very difficult to avoid some escape of fæces when this powerful bowel is opened under high pressure. The tube having been fastened in, the diseased part is cut off and the stump sutured to the top corner of the wound; the higher the better, as less gut needs to be drawn and the orifice is in a more favourable position for the truss † (*Brit. Med. Journ.*, 1895, vol. i. p. 520)." This method of inserting a tube has the advantages of being simple and rapidly used; it also prevents contamination of the wound with fæces, and further, any large vessels in the intestinal wall are closed with a single ligature. The tube becomes loose about the fourth day. The disadvantage of the tube is that its presence prevents the surgeon from fashioning a smaller artificial anus. But this is a minor point. However well the anus may look at the time, artificial support is almost certain to be required later on, when part of the sacrum and coccyx has been removed. Hence, to prevent prolapsus, and to aid in giving a patient control, such a truss-pad as that of Mr. Paul's will be found a real boon (*vide* Fig. 200).

Fig. 200.



Paul's truss for use after excision of the rectum.

Gersuny (*Centr. f. Chir.*, 1893, No. 6) advocates treating the upper end of the rectum, if long enough, by torsion, and then fixation of the twisted gut to the skin by suture. The end is grasped by catch-forceps and twisted around its own long axis until considerable resistance is experienced on attempting to introduce the finger into the bowel. He has treated two cases in this way successfully. Mr. Ball (*loc. supra cit.*) has also used it in one case, and recommends it. Dr. Gerster, of New York, has published two cases in which he adopted this plan successfully, and thinks that the method deserves preference and extensive trial (*Med. Record*, Feb. 10, 1894; *Ann. of Surg.*, Oct. 1895, p. 499).

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* This would appear to me to run some risk of carrying up cancer cells on the upper edge of the glass tube, and perhaps infecting the cut edge of the bowel above, when the gut is severed very shortly after.

† *I.e.*, The rectal pad carried by the truss will be more out of the way, especially when the patient is sitting down. Mr. Paul's truss is figured in the above-mentioned paper.

Witzel* reports (*Centr. f. Chir.*, 1894, No. 40) six successful cases in which the end of the rectum was treated as follows. A short incision having been made a little above the free margin of the glutæus maximus, this muscle is perforated with a blunt instrument, and the rectal stump drawn through, the edges of the gut being united to those of the skin.

Murphy's button has also been used to unite the ends of the bowel, a successful case being described by Taylor (*loc. supra cit.*) in which "the button was removed on the tenth day by gentle traction through the anus and the bowels were made to act. Some fæces, however, came by the wound." The fistula rapidly contracted and was completely closed about six weeks after the operation.

Taylor also describes a successful case treated by the method of Moulonguet of Amiens. "He removes the mucous membrane of the lower segment down to the anus, taking good care not to injure the external sphincter. When the cancer has been excised he draws down the upper end and sutures it to the sphincteric orifice. Moulonguet remarks that with this method there is less chance of abscess and fistula, since the intestine opens on to the exterior."

Keen (*Journ. Amer. Med. Assoc.*, 1898) is in favour of total closure of the lower end and establishing a permanent abdominal anus. He performs a preliminary inguinal colotomy, and about a fortnight later removes the rectum by Kraske's method. The lower end of the bowel is, however, closed entirely by means of sutures. The advantages claimed are that neither fæces nor mucus escape into the wound, so that primary union may be obtained; that, since there is no escape of fæces or mucus after recovery, the patient need not wear a napkin; and, thirdly, that prolapse is avoided.

The question of the treatment of the end of the rectum having been decided, the gut placed in the position which it is to occupy, and a source of contamination thus removed, the wound must be attended to. The deep recesses of the wound are then most thoroughly cleansed by irrigation with lot. hydr. perch. (1 in 4000), iodoform or glutol, carefully dusted in, and the chief cavities of the wound filled with drains of iodoform gauze. Oozing must be checked by irrigation with hot fluids, leaving on Spencer Wells's forceps, or plugging. Drainage-tubes must be inserted at points where there is obstinate oozing, or pockets difficult of thorough cleansing.†

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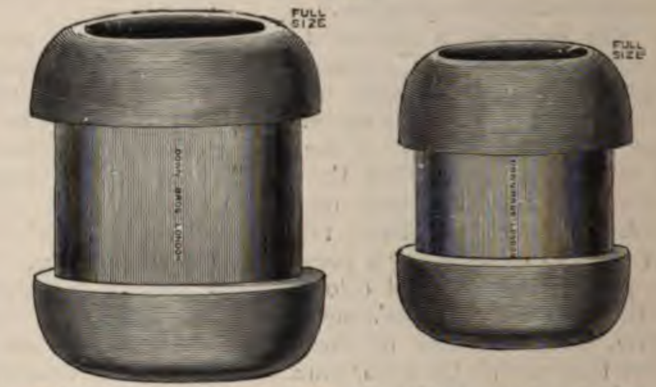
* Willems and Rydygier had recommended a similar step before, from experiments on the dead body (*Centr. f. Chir.*, 1893, No. 19; 1894, No. 45).

† I have no space to allude to the many modifications of Kraske's operation: parasacral, osteo-plastic, and others. As in many other operations, these modifications do not appear to me to be improvements. Moreover, most of them, owing to their additional severity, are quite unsuited to the patients who come to us with rectal cancer. Many of them are mentioned in a helpful article by Dr. A. G. Gerster (*Ann. of Surg.*, Oct. 1895, p. 485).

The Management of Defæcation.—Here there is a divergence of opinion. The majority of surgeons have endeavoured to retard as long as possible the first action of the bowels. This—the bowel not acting till the sixth or eighth day—is facilitated by previously emptying them thoroughly (p. 501). Others have held that if the bowel can be brought down satisfactorily under the cut sacrum or into the perinæum, and the recesses of the wound kept plugged, an early action of the bowels will be safe. Much must depend on the state of the patient as to flatulent distension, a condition which is very variable in different individuals.

(iii) **Excision of the Rectum by the Vagina.**—This method was introduced by Campenon (*France Médicale*, 1894) and Rehn (*Centr. f. Chir.*, 1895, No. 10). The rectum and vagina having been disinfected, the posterior vaginal wall is divided vertically along the middle line, together with the rectum, the incision being carried through the perinæum to the anterior margin of the anus, where it stops or bifurcates, according as the anus is to be removed or not. The bowel is separated from the vagina by careful dissection, and having been freed behind, is divided above the disease between two ligatures applied as a protection against fæcal infection. The upper part is drawn out of the way by an assistant towards the symphysis, any tissues holding it down being thus put on the stretch and easily divided. The surgeon then taking the diseased segment deals with it either by entire removal, or resection, if the anal orifice can be spared. If the peritonæum is not opened, the growth is cut away, and the bowel drawn down and sutured. If, however, the peritonæum must be opened, this is easily done, any glands in the meso-rectum removed, and the highest part of the rectum drawn down. The precautions already given as to the treatment of the meso-rectum and its vessels (p. 511) must be remembered here. The peritonæal opening is, later, to be sutured. The upper end of the gut is sutured to that left just above the anus if possible, the perinæal and vaginal wounds are also sutured, drainage being provided by two tubes placed on either side of the rectum, and brought out in the ischio-rectal

FIG. 201.



Mayo Robson's decalcified bone bobbins (p. 241), latest pattern. Largest size for operation on the large intestine. (Down's Catalogue.)

fossæ. Rehn's case, an aged woman of 81, died of septic peritonitis on the third day. Campenon reports a recovery.

(iv) **Excision of Rectum by Laparotomy.**—This mode of attacking rectal cancer is justifiable where the growth is situated very high up, at the junction of the rectum and sigmoid flexure, too high for the employment of the sacral route, and too low to be reached by the far safer resection from the left iliac fossa (p. 259).

The bowels having been most thoroughly emptied, the bladder is emptied by a catheter, and the abdomen opened by an incision in the middle line, brought as low down as possible. The small intestines are then packed out of the way, and the growth, if possible, brought well up into view. Trendelenberg's position (p. 387) may facilitate this. If adhesions interfere with safe manipulation of the growth, the operation should be abandoned. If it is possible to proceed, the following steps are open to the surgeon: (A) To resect the growth, and to unite the ends with a large-sized Robson's bobbin (p. 514, Fig. 201) or Murphy's button (p. 236). If the bowels are empty, and if the patient's condition calls for speedy operating, this position is one most favourable to the button. Every possible care must be taken with clamps and the assiduous use of gauze sponges to secure that no infection of the wound takes place. Another method, Maunsell's (p. 233), which has been successfully used for the removal of an intussusception (Hartley, *New York Med. Journ.*, Oct. 22, 1892) is also applicable to carcinomata.

(B) Paul suggests (*loc. supra cit.*) that in cases where the bowels are not emptied the safer plan would be "to double ligature, and divide the bowel above the growth, taking the upper end out through a small separate wound in the inguinal region, where subsequently a tube could be inserted and an artificial anus established. Then excise the diseased portion of the rectum, and invaginate and close the lower end."

(v) **Excision of the Rectum by the Abdomino-perinæal Method.**—This plan, which is advocated by M. Quénu, of Paris, is thus described by Allingham (*Med. Ann.*, 1901, p. 464): "A preliminary sigmoidostomy is carried out some days beforehand. The belly is opened in the middle line, and both internal iliac arteries are ligatured. The already existing sigmoid anus is liberated, and the bowel is completely cut across with the thermo-cautery. The cut ends are cleansed and enveloped in iodoform gauze. The upper end is then brought out in the left iliac region, and constitutes the permanent anus. The lower end is freed by dividing the meso-sigmoid and meso-rectum along the entire length of the hollow of the sacrum. It is then packed with gauze at the lower part of the pelvis. The abdominal wound is closed. The patient is then placed in the lithotomy position, and the final steps of the operation are carried out from the perinæum. After plugging the anal canal, semilunar incisions are made on either side of the anus, the levatores ani are divided, the anterior wall of the rectum is carefully liberated, the pouch of Douglas is opened, the remaining connections are divided, and the diseased segment of bowel (along with the gauze stuffing in the pelvis) is brought out of the wound and removed. In two cases in which the author carried out the above operation successfully 'there was not the slightest shock'—a fact which was corroborated by M. Nélaton, who was present."

Such a severe operation as the above can, however, be very rarely needed, and, moreover, patients suffering from rectal cancer would only very exceptionally be in a condition to undergo such an operation with any chance of a successful issue.

After-treatment.—The chief points here are to keep the wound sweet by frequent syringing with dilute mercury perchloride solutions, the careful insufflation of iodoform, and the keeping all pockets dry. The catheter will probably be required, and a mild aperient may be given about the sixth day, if needed. The finger should be occasionally passed with the utmost gentleness, and after a week or ten days, a bougie, or vulcanite tube (p. 501).

Question of Colotomy before Excision of the Rectum.—Theoretically, this preliminary step would seem very advisable, as diverting the fæces, and thus a source of decomposition, and as doing away with the need of the use of bougies to prevent contraction (Haslam, *St. Thomas's Hosp. Rep.*, vol. xviii. p. 151). From a practical point of view, I do not think a preliminary colotomy advisable, save in an early case (where time has not slipped away), and in one where the disease extends high up. It wastes precious time, and entails two operations in patients too often with poor vitality and too little power of repair. Moreover, the results of excision of the rectum, especially those of Mr. Cripps and Mr. Allingham, show that this preliminary is not needed. Finally, as remarked by Mr. Ball, the advantages of retaining a fæcal outlet in the perinæum are great, so long, of course, as this is not contracted.

Causes of Trouble and Failure after Excision of the Rectum.—1. Shock. 2. Hæmorrhage. This will rarely be difficult to deal with at the time, or met with later, if the surgeon has plenty of Spencer Wells's forceps, good assistants, and, if he does the operation steadily, controlling each vessel as met with.[*] This, aided by hot injections (p. 513) and firm sponge pressure, will usually prevent any secondary hæmorrhage. If this should occur, Prof. Macleod's advice should be followed—viz., to pass a large tube into the bowel for the escape of flatus, &c., and to pack carbolised sponges, or strips of gauze, firmly round this. 3. Suppuration. Cellulitis and other septic troubles 4. Peritonitis. 5. Exhaustion. 6. Recurrence.

After the high removal the above will be present in intensified form. In addition the following must be remembered: 7. Gangrene of the stump of the bowel from over-interference with its blood-supply or retraction of the superior hæmorrhoidal artery (Morestin, quoted by A. G. Gerster, *loc. supra cit.*, *Gaz. des Hôp.*, 1894, p. 326). 8. Sacral fistula. This may be *primary* from defective sutures of the bowel, or *secondary* from the formation of (9) a stricture after resection.[†] 10. If the fistula does not close it must be submitted to a plastic operation. 11. Prolapsus. This may date to the operation, or to straining afterwards and yielding or bursting of the scar. This tendency will be met by the use of Mr. Paul's truss or one like it (p. 512).

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[*] Mr. Cripps has shown that, as most of the bleeding comes from vessels situated in the walls of the rectum, dragging down the bowel with a firm grasp will not only greatly facilitate the operation, but also prevent hæmorrhage.

[†] A. G. Gerster (*loc. supra cit.*) holds that resection has been invariably followed by a stricture, no matter what form of approximation—suture, Murphy's button, or invagination—is used. Frequent digital examination is indispensable; the stricture, if detected early, will yield to systematic dilatation with a bougie.

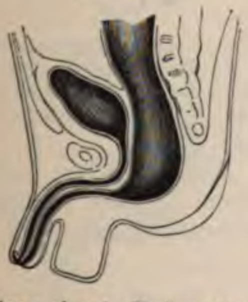
IMPERFORATE ANUS.—ATRESIA ANI.—IMPERFECTLY DEVELOPED RECTUM (Figs. 202–208).

A surgeon, when called upon to explore these cases, will do well to bear in mind the following natural and practical classification, because on this depends his treatment:—

Two Main Varieties: A. Cases in which no normal anus exists—**Imperforate Anus.** B. Cases in which a normal anus exists, but the gut is obstructed higher up, or undeveloped—**Imperforate Rectum.**

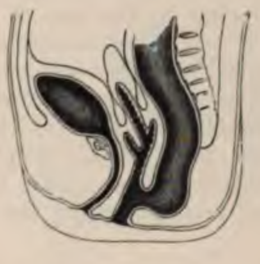
A. *Imperforate Anus.* 1. Anus partially closed—(*a*) by adhesions of epithelial surfaces, as occasionally happens in the labia of a female infant; (*b*) by a membrane. 2. Anus completely closed, but only by a membrane. 3. Anus completely closed by a membrane, but a fistula exists—(*a*) on the surface of the body (*e.g.*, the raphé of the scrotum); (*b*) into the vagina (Fig. 203); (*c*) into the urethra or bladder (Figs. 204, 208). 4. Anus imperforate and the rectum deficient as well.

FIG. 202.*



Anus absent. Rectum opening by fistula, close to urethra. (Rushton Parker.)

FIG. 203.



Anus absent. Rectum communicating with vagina. (Rushton Parker.)

B. *Anus in natural position, but the Rectum is deficient*†—(*a*) the rectum is deficient for a short distance only, and separated from the anus by a *cul-de-sac* (Fig. 206); (*b*) the rectum is deficient for a long distance, or entirely (Fig. 207).

Treatment.—A. Those in which no natural anus exists.

1 and 2. If the atresia be due to epithelial adhesions, or to a more or less complete membrane, the former should be broken down and the latter snipped away with scissors, and the opening kept patent by a small piece of oiled lint, the nurse's little finger being introduced twice daily.

3. If the anus be imperforate, and a fistula open (*a*) on the surface of the body, (*b*) into the vagina, or (*c*) urethra:

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[*] This, and the next six figures, are taken (with a few alterations) from an article by Mr. Rushton Parker (*Liverpool Med. Chron.*, July 1883).

[†] As Mr. Holmes has shown, these cases are important, as they are liable to be overlooked till considerable distension has taken place.

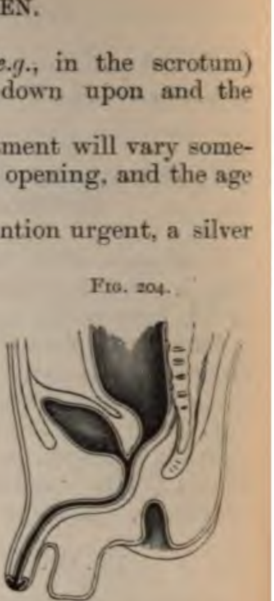
(*a*) A probe is passed from the skin-fistula (*e.g.*, in the scrotum) towards the proper anal site; it is then cut down upon and the opening established in the proper position.

(*b*) If the fistula open into the vagina, the treatment will vary somewhat with the urgency of the case, the size of the opening, and the age of the child.

Thus, if the opening be very small and the retention urgent, a silver director should be passed through the vaginal fistula back to the proper site of the anus, and there cut down upon. If the bowel is within reach, it should be drawn down and stitched *in situ*. The orifice should be kept patent.

In such a case, though an anus is established in the proper position, it is very doubtful if the vaginal fistula will close, and a further operation will probably be required later on. Plastic operations should not be tried too early on account of the softness of the tissues and the liquid condition of the fæces.

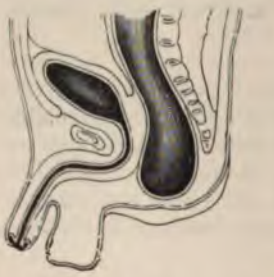
FIG. 204.



Anus ending in a *cul-de-sac*. Rectum opening into urethra far back. A case for Littré's operation. (Rushton Parker.)

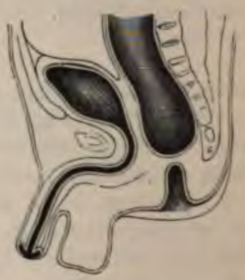
If, owing to the size of the vaginal fistula, there is not much retention, and especially if the child be not very young, the following operation may be performed after the method of Rizzoli (quoted by Mr. Holmes, *Syst. of Surg.*, vol. iii. p. 788): An incision is made from the vulva to the coccyx in the middle line, the rectum found by most careful dissection, separated from the vagina, and then brought down and fixed in its natural position. To aid in finding the rectum, a probe should be passed from the fistula.

FIG. 205.



Anus absent. Rectum could be reached by dissection. (Rushton Parker.)

FIG. 206.



Anus ending in *cul-de-sac*. Rectum readily reached from this. (Rushton Parker.

After the rectum has been brought down and secured, the incision between the anus and vulva is united to form a new perinæum.

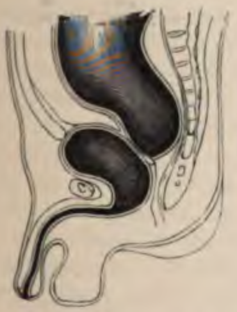
(*c*) Fistula into the urethra or bladder. Two questions here arise, How high up is the communication? How much of the bowel is deficient?

If the perinæum seems fairly developed, if the ischial tuberosities are not in close contact, if any bulging can be detected at the natural site of the anus, the communication is probably recto-urethral, and an attempt may reasonably be made to find the bowel from the perinæum. If it is found, and can be brought down, an attempt may be made to separate it from the adjacent urethra, but usually the surgeon will have to be satisfied with a free opening, and with keeping this patent, so as to encourage the urethral communication to close. If there appear no probability of the bowel being within reach, or if this cannot be found, Littré's operation should be performed (p. 103). If the child survive, the bladder must be kept carefully washed out if any fæces still find their way into it. Thus, in a case of Mr. Clutton's (*St. Thomas's Hosp. Rep.*, vol. xi. p. 84), a child about a month old died, sixteen days after Littré's operation, of suppurating kidneys, due to the offensive purulent urine.

4. Anus absent and rectum deficient as well. Here the chief question is how far upwards an exploratory operation may be safely conducted.

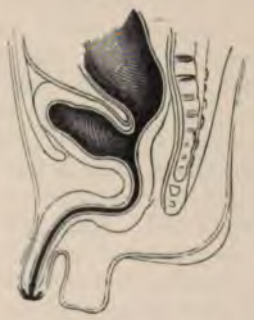
External evidence. Genitals far back and close to the coccyx, and ischial tuberosities close together, point to absence of the rectum.

FIG. 207.



Anus absent. Rectum ending high up. A case for Littré's operation. (Rushton Parker.)

FIG. 208.



Anus and rectum deficient, the bowel ending in the bladder. (Rushton Parker.)

In most cases the surgeon begins by exploring. The child being under the A.C.E. mixture and in lithotomy position, and a small sandbag placed under the sacrum, and the bladder emptied with a catheter, the surgeon, seated at a comfortable level, makes a free incision from the position of the anus back to the coccyx. Keeping exactly in the middle line, and opening up the cellular tissue with his finger-tip, aided by a scalpel and director, the surgeon works backwards towards the concavity of the sacrum, constantly taking note with his finger-tip of the depth to which he has got, while an assistant aids in bringing down the bowel by supra-pubic pressure.

As a rule, two inches are a sufficient depth in a new-born child. If still in doubt whether to proceed or no, the surgeon may make a careful puncture with a morphia-syringe backwards, and note the condition of the point; no puncture with a trocar is justifiable at this depth.

Points to bear in mind.—1. The rectum may end at the brim of the pelvis. 2. If it end lower down, it may be floating with a long meso-rectum. 3. Though the rectum may end within reach, the peritonæum may, and not infrequently does, extend low down on the bowel. 4. Even if the rectum is successfully opened high up, without opening the peritonæum, fatal cellulitis may be set up by the escaping fæces, or by the attempts to keep the bowel patent.

If the above exploratory operation fail, inguinal colotomy or Littré's operation should be resorted to (p. 103).

B. **Imperforate Rectum.**—The treatment here will be an exploratory operation, followed, in case of failure, by Littré's operation (p. 103).

CHAPTER XV.

RUPTURED PERINÆUM (Figs. 209, 210).

THE following account is taken from my colleague, Dr. Galabin:*

A. **Operation for Partial Rupture** (Fig. 209).—The patient is placed in lithotomy position. The need for assistants to support the thighs is avoided if a "Clover's crutch" is used.

"The extent of surface to be freshened is indicated, to some extent, by the cicatrix left by the rupture. It is well, however, to go a little beyond the limits of this in all directions, especially up the median line of the vagina and towards the lower halves of the labia majora, both in order to secure, if possible, a perinæal body somewhat larger and deeper than the original one, and to allow some margin, in case the surfaces do not unite completely up to the edges. To put the mucous membrane on a stretch, an assistant at each side places one or two fingers on the skin of the thigh and draws the vulva outwards (Fig. 209). The skin just beneath A, in front of the anus, may also be seized by a tenaculum and drawn downwards. If still the mucous membrane is not sufficiently on the stretch, from laxity of the vagina, the posterior vaginal wall, some distance above B, should be seized by long-handled tenaculum-forceps and pushed upwards. Incisions are then made through the mucous membrane from B to A, in the median line of the vagina, and from A to C and D through the junction of mucous membrane and skin. These should not be extended in the direction of C and D farther than the lower extremity of the nymphæ at the utmost. There are then two triangular flaps, ABC and ABD. These are to be dissected up from the apex A towards the base BC and BD, the corner of the mucous membrane at A being seized with dissecting forceps. The dissection should not be deeper than necessary, and if it is done with the knife the surfaces are more ready to unite. If, however, there is much tendency to bleed, scissors may be used. The apices of the flaps are then cut off with scissors, leaving an upturned border along BC and BD. When the surfaces are drawn together these borders form a slightly elevated ridge towards the vagina, and if there is any failure of union just along the edge they fall over and cover it.

"The best material for sutures is the silkworm- or fishing-gut, which should be stout, of the thickness used for salmon flies. It may be stained with magenta, to render it more easily visible. This has all the advantage of silver wire, as being non-absorbent, while, at the same time, it is easier to manipulate, and the exposed ends do not cause discomfort after the operation, like those of wire. The sutures are placed as shown in the figure. The most convenient needle is a slightly curved one, not too thick, mounted in a handle. This is passed in, unthreaded, rather close to the edge of skin, brought out on the raw surface, then threaded with the end of the suture, which is so drawn through. By passing the needle in the same way on the other side, the other end of the suture is drawn through. Another mode is to use a more curved needle, and to bury the sutures, 1, 2, and 3, in the tissues throughout their whole course. If, however, they are brought out in the centre for spaces alternately short and long (Fig. 209), the surfaces are more easily brought into contact at all levels without undue tension. In passing sutures 4, 5, 6 the needle should be brought out precisely on the margin along which the border of mucous membrane BC, BD is turned up from the vagina, not passing through the mucous membrane itself. The sutures are then tied in the order of the numbers 1 to 6, care being taken that the surfaces are brought just sufficiently into apposition, and that no clots or blood are left between them. The bleeding, if any continues, is arrested by bringing the surfaces together, and if they are properly united there will be no secondary hæmorrhage, unless the sutures begin to cut from excessive tension. The sutures may be left in from seven to ten days."

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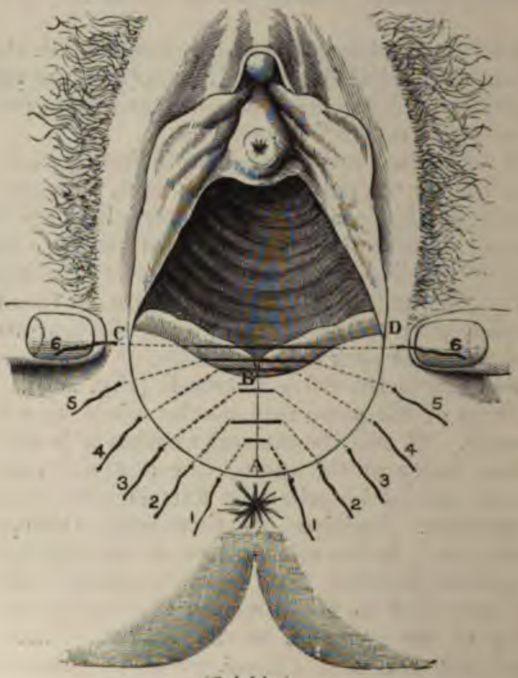
* *Diseases of Women*, pp. 130, 381. Anyone making trial of this method will agree with me as to its simplicity and excellent results.

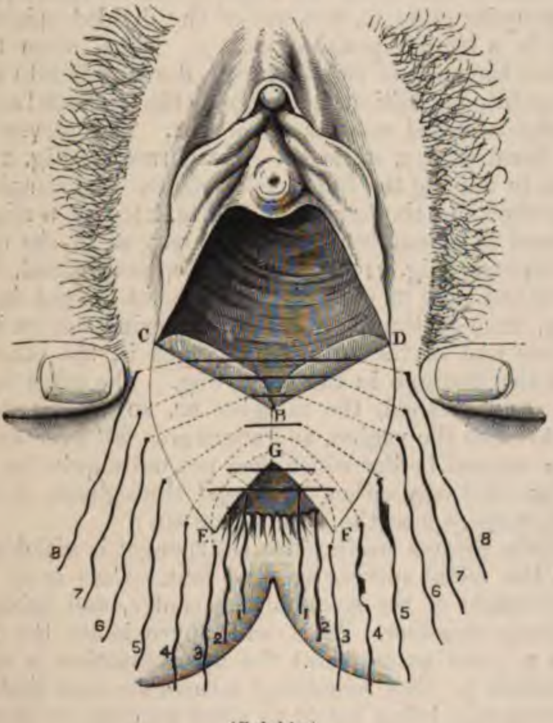
FIG. 209.



(Galabin.)

Operation for Complete Rupture (Fig. 210).—The preliminary steps are taken as above. "A point B in the median line of the vagina, a sufficient distance above the apex of the rent in the septum, is taken, and an incision through the mucous membrane is made from B to G, and from G to E and F along the edges of the septum, between the rectal mucous membrane and the cicatrix. Incisions are also made through the skin from E to C and F to D, so that the freshened surface may extend somewhat beyond the limits of the cicatrix, C or D not to be higher than the lower extremities of the nymphæ. The quadrilateral flap, EGBC is then seized at E by dissecting forceps, and dissected up with the knife from the angle E, and afterwards from the angle G, towards the base BC. While this is done, the parts are kept on the stretch by an assistant drawing down the skin below E with a tenaculum. The flap is then cut away with scissors, except an upturned border, which is left along BC. The flap FGBD is treated in a similar manner. If, as is usual, the ends of the sphincter at E and F have retracted from the margin of the cicatrix, it is well to cut away with the scissors a narrow strip of rectal mucous membrane, generally somewhat everted, a short distance from E and F towards G, so as to bring the freshened surface to the ends of the sphincter.

FIG. 210.



(Galabin.)

"Sutures of silkworm-g[illegible] then applied in the following manner:

First, rectal sutures, either two or three, according to the extent of the rent in the septum, are applied. These are destined to be tied in the rectum, and the ends left projecting through the anus. They are best applied with a half-curved needle, held in a holder. The needle is passed in a little distance from the margin of the rent, and brought out almost at the very edge of the rectal mucous membrane, on the line GF. The needle is then threaded at the other end of the suture, and that is drawn through in the same way from without inwards, on the margin EG. Next, two sutures at least are passed completely round through the remnant of the septum, by means of a curved needle, not too large, mounted in a handle. This is passed unthreaded, and draws the suture back with it on withdrawal. The first of these (3, Fig. 210) is passed in somewhat behind and below the angle F, so as to take up, if possible, or at least go quite close to, the end of the divided sphincter, and is brought out in a similar position near E. Thus, when tightened, it brings together the ends of the sphincter, drawing it into a circle; but it often brings into apposition, not so much the freshened surfaces above as the unfreshened rectal mucous membrane. This serves as a barrier to keep out fæcal matter, while the next suture (4, Fig. 210) aids the rectal sutures in uniting the freshened surfaces. The remaining sutures are passed as shown in the figure (5—8, Fig. 210) by a slightly curved needle mounted in a handle, in the same way as in the operation for incomplete rupture (Fig. 210). The needle, unthreaded, is passed in pretty close to the edge CE or FD, is brought out (except in the case of suture 5, Fig. 210) on the line where the margin CB or DB is turned up, and draws one end of the suture back with it, the other end being afterwards drawn through in the same way. The effect is, that when the sutures are tightened, the margins BC, BD are turned up into a slight ridge towards the vagina, and afterwards fall over and cover any portion of the vaginal border which does not unite quite up to the edge. Suture 5 (Fig. 210) may either be buried throughout, or brought out for a very short space near the median line BG.

"When all the sutures are in place, the sponge* is withdrawn from the rectum, and the rectal sutures are tied first. Care must be taken to draw up the whole of the slack in the centre, and bring the edges, EG, FG perfectly together. This will approximate the ends of the sphincter to a great extent, and the approximation is completed by tightening suture 3. The remaining sutures are then tied in the order of the numbers, care being taken to allow no clots or blood to remain between, and to tighten them just enough to bring the surfaces in contact. The ends of the rectal sutures may be left moderately long, to distinguish them, the rest cut pretty short.

"The perinæal sutures are removed in seven days. The rectal sutures may be left from ten to fourteen days longer, till the perinæum is consolidated. They are then removed through a small rectal speculum, care being taken not to break down any of the union in passing it. By this operation the anus is generally much more completely restored than by the use of quilled sutures, or the plan of making deep lateral incisions to relieve tension. If there is much resistance to bringing the surface together, the only thing required is to use more numerous sutures, so as to diminish the tension on each.

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* This, secured with tape, is introduced into the bowel, to prevent the descent of any fæces left by an enema.

"In some cases, by the primary operation after labour, only superficial union is secured, and a recto-vaginal fistula is left close to the part united. The best plan is then to cut through the bridge of union with scissors at the time of the operation, and then proceed as in the case of complete rupture. This is the only way to secure a firm and thick perinæum, and is less likely to fail than an operation on the fistula alone."

CHAPTER XVI

OPERATIONS ON THE OVARY.

OVARIOTOMY.

One or two **practical points** will be alluded to before the operation is described.

Date of Operation.—An ovarian tumour should be removed as soon as possible after its discovery. For, by delay, not only is the patient subjected to the risk of accidents in connection with the tumour itself, but her general health is likely to suffer from the effects of pressure on neighbouring organs.

Accidents in connection with Tumour.—The accidents to which an ovarian tumour is liable should be borne in mind. They are shortly, as follows:—

(1) *Inflammatory Changes.*—These, whether confined to the peritonæal covering or dependent upon inflammatory and necrotic changes in the cyst itself, will lead to adhesions between the tumour and the abdominal wall or viscera. When recent, these adhesions may readily be separated, but when old and fibrous they may lead to serious difficulties in the course of the operation. The contents of the cyst may suppurate, and, fouling the peritonæal cavity, lead to suppurative peritonitis.

(2) *Torsion of the Pedicle.*—When slowly produced, the interference with the blood-supply to the tumour will set up necrosis and so render the cyst-wall liable to rupture. Acute torsion will lead to bleeding, which may be so profuse as to rupture the cyst-wall and endanger the patient's life. Under these circumstances an immediate operation is called for, with all the disadvantages that an operation of urgency entails.

(3) *Rupture of the Cyst.*—This may, as has been mentioned, follow necrotic changes in the cyst or torsion of the pedicle. It may, in addition, depend merely upon thinness of the wall or upon weakening due to the extension of growth from the interior through the cyst-wall. As a result the contents become disseminated through the peritonæal cavity, setting up peritonitis in certain cases, or leading to a general infection of the peritonæum with growths in others.

(4) *Malignancy.*—We have, finally, to remember this important practical point, that it is difficult at an early stage to say whether we are

dealing with a malignant growth or not. It is especially in children that an early removal is demanded, for in them the proportion of malignant growths is much higher than in adults. Mr. Bland Sutton found twenty-one cases of sarcoma in a series of one hundred ovariotomies performed in girls under the age of 15. (*Bland Sutton, Surgical Diseases of the Ovaries and Fallopian Tubes*, 1896, p. 178.)

General Condition of the Patient.—The condition of the viscera, kidneys, lungs, &c., the habits of the patient, her digestive powers, must all be carefully noted. For upon a consideration of these points, not only does the prognosis to some extent depend, but also the nature and duration of the treatment to be adopted preparatory to the operation. Age need not be regarded as a bar to operation. Mr. Bland Sutton has collected eleven cases of ovariotomy in women over 80, all of whom recovered (*Bland Sutton, loc. cit.*, p. 175). The presence of albumen in the urine should not be regarded as necessarily a contra-indication to operation. Small amounts often clear up after the removal of the tumour. If chronic nephritis is known to be present, the operation should still be carried out, in most cases, after suitable preliminary treatment.

As regards difficulties likely to be met with in the course of the operation, some information will be obtained from the history of the patient and from careful examination. Attacks of pain will point to peritonitis and adhesions. An examination of the tumour will give some idea of its mobility, of the proportion of solid matter, &c.

The *amount of skill of the surgeon*, though a delicate matter, must also be mentioned. No one should operate on these cases who has not had good opportunities of seeing others operate frequently, and no one should undertake a case whose ovariotomies are, at the most, likely to be but two or three in his lifetime.

Preparation of the Patient.—The patient should be kept quiet for two or three days before the operation, in an ordinary uncomplicated case, and the bowels regulated. The diet need not be unduly restricted or altered, beyond seeing that it is easily digestible and nutritious. One or two warm baths may be taken on the day or two before the operation. On the evening preceding the operation the abdomen should be thoroughly washed, attention being paid particularly to the navel. It is better, especially in a delicate, sensitive patient, to defer the shaving of the pubes until she is under the anæsthetic. A compress of 1–2000 perchloride of mercury should then be applied. A purge should be given overnight, followed by an enema in the morning. On the day of operation a light breakfast should be taken, and some beef-tea or soup about 10, if the operation is to take place about 2 p.m. When the patient, warmly clad, especially as to her extremities, comes in to take an anæsthetic, only two or three faces that are familiar to her should be present; when she is under the anæsthetic a catheter should be passed, if the bladder has not been emptied beforehand.

Preparation of Instruments, &c.—The room, which has been thoroughly cleansed, and not rendered too comfortless for the sake of ventilation, &c., should have a temperature of about 65°. A good light, and one likely to last, should be secured. The table should be sufficiently high to save the operator stooping, and only just wide enough to hold the patient comfortably. It will be found an advantage to have a table which allows of the patient being placed in the Trendelenberg, or raised pelvic position, if necessary. A dozen new Turkey sponges, chosen for their even softness of texture, should have been carefully prepared, and four flat ones (not too large) should also be provided. A few small sponges, ready for use on holders, leave no excuse for the dividing of sponges during the operation, a course to be unhesitatingly condemned. It is well to record the number of sponges and Spencer Wells's forceps on a slate. Instead of sponges, gauze swabs and pads may be employed; these must, of course, be provided in larger numbers as they cannot be cleansed after use; they must be as carefully counted before and after the operation as are the sponges.

The following should be in readiness: Two scalpels, blunt-pointed bistoury, steel director, Key's director, twelve pairs of Spencer Wells's forceps, clamp forceps, cyst forceps, Spencer Wells's vulsellum-trocar[*] and tubing, blunt-pointed scissors, needles (twelve straight, two being threaded on each suture of stout silk or silk-worm gut for closing the abdominal wound, and fine ones, both straight and curved, for underrunning any bleeding point or introducing fine sutures if any of the contents of the abdomen are unavoidably injured), two aneurysm-needles, pedicle needle, needle holder, two retractors, sponge holders, plenty of silk and chromic-gut ligatures of varying sizes (and the material carefully prepared, including some stout enough for the pedicle), two pairs of dissecting forceps, dressing forceps, drainage tubes (both glass and rubber), Paquelin's cautery, abundance of lysol and mercury perchloride lotion, a foot-pan to stand under the table, two others to wash the sponges in, a laryngeal mirror or electric lamp. The instruments should stand, in two trays or pie-dishes, on a small wheel-table close to the operator's right hand, the ligatures and sutures should be in separate porringers, all covered with carbolic acid (1 in 40) or lysol.

In addition to the anæsthetist two assistants will be found amply sufficient, one to stand opposite the operator to assist in securing vessels, to help with the tumour, &c., whilst the second will hand instruments, thread needles, prepare ligatures, and so on. One nurse will be required to wash sponges if these are used, and another to attend to the nursing operations generally.

The Operation.

Incision of Abdominal Wall.—An incision in the median line, reaching from just below the umbilicus to within two inches of the pubes, is made through skin and fat. There is no object in having the incision more than three inches long to commence with, as it can be lengthened as required subsequently. After dividing the skin and fat, the layer of fascia which forms the sheath of the recti muscles comes into view. If the muscles are in apposition, one or both of them will be exposed on incising the fascia; the interval between them should be sought for and the two muscles separated for the length of the incision. If the linea alba is missed, and a difficulty is experienced in finding the median line, a director or the handle of the scalpel should be introduced beneath the fascia; the director will be arrested on the side on which the linea alba lies.

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[*] One or two smaller trocars should also be in readiness.

If the recti are separated an incision through the fascia in the median line at once exposes the sub-peritonæal fat and peritonæum. Before this is incised Spencer Wells's forceps are applied to every bleeding point; these may be left on until the operation is concluded; any bleeding points then persisting should be treated by torsion and not by ligature, as these latter weaken the cicatrix. The peritonæum, readily recognised, when healthy, by its delicate fasciculation and translucency, is carefully picked up by a pair of forceps so as to include nothing else, and an incision is made in it horizontally with a knife. As soon as the peritonæal cavity is opened the intestines fall away from the abdominal wall. The peritonæum is then slit up on two fingers for the length of the incision; the fingers used in this way as a director are enabled to detect the height to which the bladder comes at the lower part of the wound, and so determine the limit to which the peritonæal incision may safely be carried below.

Mr. Doran (*Ann. of Surg.*, May 1888) thinks a mistake is often made in not bringing the incision near enough to the pubes, which may cause much trouble when the pedicle has to be drawn out, and greatly impede a thorough exploration of the pelvis.

Care should be taken not to mistake the sub-peritonæal fat for omentum, as this may lead to extensive stripping off of the peritonæum from the abdominal wall, an accident likely to be followed by sloughing of this structure.

In an easy case without parietal adhesions the pearly glistening cyst comes into view as soon as the peritonæum is incised; but if the peritonæum is thickened and adherent to the cyst there may be the greatest difficulty in deciding when this is reached, and the incision may even be carried through the cyst-wall. In cases of difficulty the incision should be prolonged upwards to the left of the umbilicus until a spot free from adhesions is found.

When the tumour is exposed it should be examined carefully by eye and hand. Its nature should be noted, whether cystic or solid, or partially solid, whether a dermoid or inflamed; the presence of adhesions should be ascertained or secondary malignant deposits, rendering further operation unadvisable. If we are dealing with an uncomplicated cystic tumour of the ovary, the first proceeding is to tap it. To separate adhesions before tapping is, in Mr. Thornton's words (*Dict. of Surg.*, vol. ii. p. 153), "bad practice, because if they are separated while the parietes and cyst wall are both stretched by the fluid, all the little vessels in them bleed, and very serious hæmorrhage may occur out of sight during the subsequent emptying of the cyst; whereas if the cyst be first tapped, the contraction of both parietes and cyst wall closes the smaller vessels."

Emptying the Cyst.—The abdominal incision should be packed round to prevent fluid running back into the abdominal cavity. The cyst is next tapped by carefully plunging in a Spencer Wells's trocar, then guarding the point with the inner tube, and as soon as the walls of the cyst are rendered lax enough by the escape of the contents, attaching the claws to the cyst wall so as to keep this on the trocar, as forward traction is made.

Dr. Baldy (*Syst. of Gynæcol.*, 1894) points out that the puncture should not be made at the lower angle of the wound, for the reason that as the cyst empties it retracts, and leaves the opening situated below the wound, increasing the difficulty of preventing fluid from entering the peritonæal cavity. As soon as the trocar is inserted into the cyst, the assistant should place a hand low down on each side of the abdomen, and press steadily and firmly. By this means he not only forces out the fluid from the cyst, but keeps the abdominal incision taut over the tumour, thus preventing the contents of the cyst from running into the peritonæal cavity. As the cyst empties traction is applied to it by means of the claws of the trocar or by other forceps, and if there are no adhesions it is readily brought out of the wound.

If there is difficulty in delivering the tumour, and it is clear, from the bulk of the cyst remaining after tapping, that it is multilocular or solid, it will have to be further reduced in size before extraction. If it is multilocular it must be tapped again in two or three more places by removing the trocar and closing the puncture with cyst forceps, and then, while the cyst is dragged forward and steadied, the first trocar or a smaller one is thrust in at other spots where fluid is still present. This is a better practice than thrusting the trocar from the first puncture into other parts of the cyst in the dark. If this latter method is adopted, the hand should first be pressed into the abdomen to make sure that the trocar does not perforate the cyst wall and injure the viscera. In cases in which the tumour is composed of a large number of small cysts, or in which the contents are so viscid that they will not escape through the trocar, the opening should be enlarged and the hand passed into the cyst to break down the numerous septa or scoop out the viscid contents.

If the bulk of the cyst is solid, the trocar puncture having been enlarged and clamp forceps firmly keeping forward the edges, the surgeon first introduces two or three, then, perhaps, all the fingers of one hand and scoops out the solid material till the bulk of the cyst is sufficiently reduced to come through his incision. It is preferable, however, to enlarge the incision upwards sufficiently to allow of the mass being brought out entire, its long axis being tilted into that of the wound. In these cases it is especially important to avoid any leakage of the contents into the peritonæal cavity, as portions of the tumour thus carried in may give rise to a recurrence of growth.

If the wound requires enlargement, this is best done with a blunt-pointed straight bistoury or a pair of scissors and the use of two fingers as a director, the incision being carried to the left of the umbilicus so as to avoid any still open vessel in the round ligament.

The enlargement of the wound may be found necessary when the ovarian tumour is solid or contains such a proportion of solid material as to render its delivery through the original incision difficult. When feasible, this is a better plan in the latter case than scooping out the contents, as this proceeding is often attended with considerable hæmorrhage, and is, moreover, likely to be followed by reinfection of the peritonæal cavity. The wound should be enlarged when, from the previous history or the appearance of the tumour, there is reason to believe that suppuration has occurred. Many surgeons prefer to remove dermoids, unless of large size, entire, to obviate the risk of the oily contents escaping into the abdominal cavity.

Treatment of Adhesions.—As the cyst is emptied and drawn forwards, any adhesions that are present must be dealt with, and the ease with which they are separated will depend upon whether they are recent or not. Those between the tumour and abdominal wall are readily separated, when recent, by sweeping the hand between the two adherent surfaces. If of longer duration the separation must be effected, bit by bit, with the finger-nail or scissors, any persistent bleeding points being secured by Spencer Wells's forceps and tied. Another method is to under-run any bleeding points, especially any obstinate ones in the parietal peritonæum. Adhesions to the omentum, which are the most common, must be ligatured and divided, the number of ligatures used depending on the extent of the adherent omentum. Mr. Herman (*Diseases of Women*, 1898, p. 797) points out that holes frequently exist in large pieces of adherent omentum, and he advises that in cutting the omentum away the incisions should be carried through these holes to obviate any subsequent risk of intestines being strangulated in them. Intestinal and other visceral adhesions may present considerable difficulties. If the bowel is adherent it should be very carefully peeled by means of the thumb-nail from the cyst. If it cannot be detached in this way a thin strip of the cyst wall should be cut away and left adherent to the intestines. Firm adhesions in the pelvis present the most difficulty, and in the separation of them by means of the fingers a hole may be torn in the rectum. Injury to large vessels is not common. In Dr. Baldy's "Gynæcology," however, a case is recorded in which death resulted from hæmorrhage due to injury of a large vein in the removal of an ovarian cyst. Though bleeding from large vessels is not common, it is especially in cases of extensive pelvic adhesions that we get troublesome oozing. If the bleeding is coming from one or two points it may be possible to seize them with artery forceps and secure them with a ligature. This procedure will be much facilitated by having the patient in the raised pelvis position. If, as is commonly the case, the oozing is general, the pelvic cavity should be firmly packed with long strips of sterilised or iodoform gauze, the ends of which are brought out through the lower part of the wound. The sutures should be introduced as usual into the lower part of the abdominal incision, but should be left untied, ready to bring the edges of the wound together when the plug is removed. The gauze should be taken out forty-eight hours after the operation. By that time it will have served its purpose, the arrest of the oozing. It will be found that the plug is more easily removed then than later, though some operators recommend that it should be left in a week. This method of treatment by packing is a much more reliable and, on the whole, safer method than the older ones of cauterisation or touching with solid perchloride of iron. If packing with gauze is used for troublesome pelvic oozing, the cautery will be very seldom required. Mr. Herman, who has never had occasion to use the cautery, says, with regard to its employment in the pelvis—"Large vessels lie so close under the peritonæum that I should fear to burn extensively in this region." With regard to the use of iron perchloride, the only condition that demands its use, viz., general oozing, is better met by the use of the gauze tampon.*

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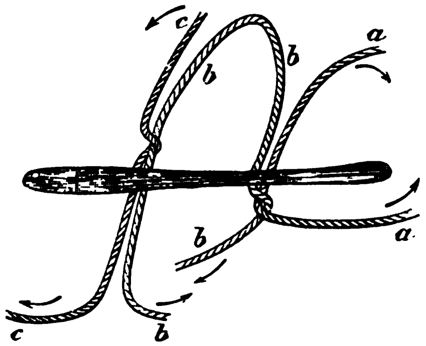
* Mr. Thornton (*loc. supra cit.*) gives the following advice respecting the use of iron perchloride:—"The surfaces to be touched should be dried with a sponge: then a

Treatment of Pedicle.—When the cyst has been sufficiently brought outside, the pedicle is dealt with.

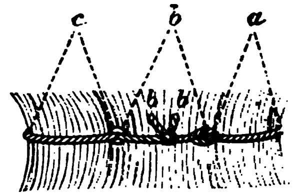
FIG. 211.



(Doran.)

The centre of the pedicle being found by unfolding it, a blunt pedicle needle loaded with silk (No. 4) is made to perforate it here at a spot devoid of vessels. The loop of silk being drawn through and the needle withdrawn, the loop is cut, and the two ligatures tied firmly round the two halves of the pedicle. To make the silk hold in a stout pedicle, it is well to loop the ligatures round some blunt instruments, so as to tie them with sufficient force. When they are both tied, one is cut short, while the other is thrown round the whole pedicle and tied again. The cyst is then cut away, not more than three-quarters of an inch and not less than half an inch, from the ligatures. When this is done, the cut end is carefully examined, to make sure that no bleeding is taking place. The pedicle is then allowed to drop in, and the finger, following it down to the uterus, finds and hooks up the other ovary. If this is found enlarged, it must be removed. When the pedicle is very broad, a second or a third transfixion will be needed. The second must be thus performed: The thread for the outer loop (*a*, Fig. 212) is twisted on one side of the pedicle round the outer thread (*b*), then the outer loop is tied. The pedicle-needle (a long unhandled one with a large eye is the best) is then threaded, first with a single ligature (*c*), and then with one end (*b*) of the untied thread already passed through the pedicle. The transfixion is then performed (Fig. 212). The third thread (*c*) must be once twisted around the second (*b*); this is best done, perhaps, on the side where (*b*) forms a loop (Fig. 212). Then, on the opposite side, the two free ends of the second thread (*b*) are firmly tied. The ends of the third thread (*c*) are then tied on the inner side of the pedicle. The threads will then lie as in Fig. 212, firmly interlocked and holding the pedicle tightly. Should a third transfixion be required, the third thread, instead of being tied, must be threaded on the needle in company with a fourth, and the process just described repeated, care being taken to interlock the threads as

FIG. 212.



(Doran.)

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small sponge, well-wrung, should be smeared lightly with the solid perchloride, and firmly pressed against the bleeding surface till the oozing stops; a large flat sponge should be spread under the surfaces thus treated, to prevent any of the acid serum, which runs away immediately after the application of the iron, getting on to the intestines. Oozing surfaces in the pelvis are treated in the same way, the intestines being first drawn out of the way and protected by sponges."

before. If this precaution be not taken, the unlocked threads pulling in different directions will tend to tear the pedicle apart at the point of transfixion, and vessels may easily escape being commanded. As each of the above loops is tied, the ends of the thread must be cut short or needless confusion will be entailed.

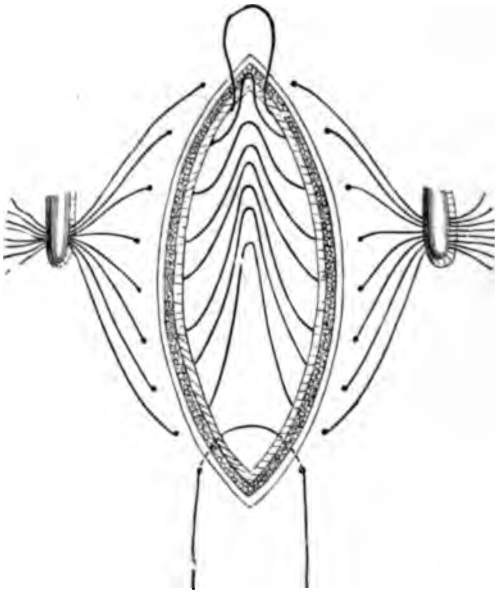
The Toilet of the Peritonæum.—The operator now scrutinises the parts, removes any jagged omentum or bands of adhesions, arrests any still bleeding points, takes out any sponges which he may have inserted and has them all counted. The next step is to sponge out thoroughly the pelvis, the spaces in front and behind the uterus, and those on either side of the vertebral column. This is effected by introducing again and again aseptic sponges or sterilised gauze swabs on sponge forceps until they return dry and colourless. In the great majority of cases this will be sufficient, and many operators employ practically no other procedure. If, however, a cyst has burst during the handling of the tumour, as sometimes happens when the wall is thin or necrotic, and viscid contents or, perhaps, papillary growths have escaped into the peritonæal cavity, it is difficult without undue manipulation of the viscera to get the abdominal cavity clean. Under these circumstances it is preferable to wash out with warm sterilised water, or sterilised water to which ·6 per cent. of common salt has been added. This is especially indicated where growth has escaped into the peritonæal cavity from a papillary cyst, on account of the possibility of reinfection from a portion of growth left behind.

Suture of Abdominal Wound.—The abdominal wound may be closed either by using one row of sutures which pass through skin, muscle, and peritonæum, or by securing the different layers separately. One row only of sutures should be used in cases in which drainage is employed, or in which the contents, though freely removed, were septic, or again, in cases in which a second operation appears probable. The introduction of a single layer is effected as follows: A flat sponge being introduced to catch any blood, the abdominal wound is closed by means of sutures of stout silk, or preferably silk-worm gut. These should be carried through peritonæum, muscle, and skin, care being taken, as Mr. Herman points out, that the stitches pass through the edge of the peritonæum only, so that this structure is not tucked in between the edges of the wound. Not only should a good bunch of muscle be included, but also the fibrous sheath overlying it. The sutures should pass through the skin about a quarter of an inch from the edge of the wound, and they should be inserted about half an inch from each other. When all the sutures have been introduced they are collected near their ends on either side with pressure forceps. (Fig. 213). The operator then parts the sutures, hooking them up and down so as to obtain free access to the abdominal cavity without any risk of pulling out a suture. The flat sponge is now withdrawn and the sutures tied, care being taken that neither omentum nor intestines become caught in the loop. Superficial sutures of fine silk or horsehair should be employed to accurately coapt the edges of the skin.

If the layers of the abdominal wall are to be sewn up separately, the first procedure is to shut off the peritonæal cavity by bringing the edges of the peritonæum together with a continuous suture of fine silk. The recti are then approximated, either by a continuous silk suture or by interrupted sutures of the same material, care being taken to bring together the edges of the fibrous layer overlying the muscle. The edges of the skin are finally sewn together in the same way.

Drainage.—Different operators vary much in their practice as regards drainage, and it is difficult to lay down any hard-and-fast rules as to when to employ it. Undoubtedly the tendency is to employ it less and less. Experiments carried out within the last few years on the absorptive powers of the peritonæum have taught us that this structure, when in a normal condition, is capable of absorbing large quantities of fluid, and also of disposing of a considerable number of pyogenic organisms introduced into the abdominal cavity. We have to bear in mind, however, that a peritonæum thickened by inflammation, such as we find in some cases of ovarian tumour, has its functions impaired, and is not in a condition to dispose of large quantities of fluid or many organisms. Consequently fluid collecting in the abdominal cavity provides a ready medium for the growth of any organisms accidentally introduced.

FIG. 213.



(Doran.)

Dr. Jellett (*Pract. of Gynæcol.*, 1900, p. 287) puts this question of drainage very clearly. "It must be regarded," he says, "as a line of treatment whose general effect is by no means beneficial, but which may have to be used at times in order to guard against a greater danger." The risks of drainage should be clearly recognised. One serious result is the weakening of the abdominal scar that attends its use, with the subsequent formation of a hernia. The drain may be a cause of re-infection of the abdominal cavity, and when a hard glass tube is employed, may, by pressure on the bowel, lead to the formation of a fæcal fistula. There is one condition in which drainage is certainly called for, and that is when any septic material, as from a suppurating cyst or a pyo-salpinx, has entered the peritonæal cavity, or when any septic focus has been imperfectly removed.

Drainage is commonly made use of after the separation of extensive adhesions. In such cases the surgeon must use his own judgment. He should bear in mind the fact that the absorptive powers of the peritonæum in such cases are impaired, and if he thinks that more exudation is poured out than the peritonæum can deal with, he must employ some form of drainage. For this purpose a glass tube (Keith's) is commonly made use of. One end rests at the bottom of Douglas's pouch without pressing on the rectum, the other passes through a thin sheet of india-rubber, its neck being firmly gripped by a hole in this. One or two sutures should be passed in the usual way through the abdominal wound, above and below the tube, but left untied until the tube is removed. A sponge is placed on the end of the tube to absorb discharges, and the india-rubber sheeting wrapped round it to prevent soiling of the dressings. The sponge should be changed at first every hour, and this is done without disturbing the dressings over the wound; later on the change should be effected every two or three or more hours. At the same time as the sponge is changed the fluid should be sucked out of the drainage tube by means of a glass syringe with a piece of india-rubber tubing attached. The syringe and tubing should be boiled before being used, and the most scrupulous precautions taken against the introductions of organisms from without. It is difficult to lay down rules with regard to the length of time drainage should be employed. When used on account of oozing from extensive raw surfaces one to two days will usually suffice. If employed for a septic case drainage may be dispensed with as soon as a bacteriological examination shows the discharge to be sterile. When, on account of persistence of purulent discharge, drainage is required for some time, the glass tube should be replaced in a few days' time by a rubber one. Mr. Herman recommends that it should be so replaced at the end of twenty-four hours in all cases where longer drainage is required. Owing to the fact that a hard tube is likely to produce a fæcal fistula by pressure on the bowel, and owing to the danger of reinfection that attends its use, many surgeons have discarded it, and now employ gauze instead. Either sterilised or iodoform gauze may be used. It should be cut into strips and its edges turned in and sewn together to prevent the possibility of shreds being detached and left behind in the wound. As it soon ceases to act as a drain it should be removed twenty-four to forty-eight hours later, fresh strips being replaced if necessary. The advantages in certain cases of drainage through the vagina are pointed out by Dr. Jellett (*loc. supra cit.*), and he considers that with a healthy vagina, drainage through the bottom of Douglas's pouch is the correct treatment in the majority of cases.

Encapsuled Ovarian Cysts.—Cysts of the Broad Ligament.—Intra-ligamentous Cysts.—Cases are occasionally met with in which the cyst growing between the layers of the broad ligament is imperfectly encapsuled and has no pedicle that can be ligatured. In these cases an attempt should be made to enucleate the tumour after making an incision through the peritonæal covering. Mr. Thornton (*Dict. Surgery*, vol. ii. p. 155) has pointed out the advisability of isolating at an early stage the vessels and ligaturing them. Dr. Kelly (*Oper. Gynæcol.*, 1898, vol. ii. p. 303), who also draws attention to the importance of securing the vessels early in the operation, points out that the blood-supply is derived from the ovarian and the terminal branches of the uterine vessels, and that these should be sought for, the former on the side of the pelvic brim, the latter on the uterine side of the cyst, after division of the peritonæum. If these are tied at once there need be but little hæmorrhage throughout the operation. The main blood-supply having been secured in this way, the tumour should be enucleated by separating with the fingers the loose connective tissue that holds it in position. The removal of the cyst will be facilitated by emptying it of its contents with a trocar in the usual way. Any bleeding points in the capsule should be seized with pressure forceps and secured. "In performing these enucleations the operator must always bear in mind the fact that he is constantly brought into dangerously close relations with bladder and ureters, rectum and sigmoid flexure, or cæcum and appendix. The large iliac vessels are also occasionally incorporated with the capsule" (Mr. Thornton, *loc. supra cit.*).

After the removal of the cyst the capsule requires attention. If it is very redundant it may be gathered up into a loose fold, transfixed and tied, like an ordinary pedicle (Mr. Bland Sutton, *Surg. Dis. of Ovaries*, 1896, p. 372). If the cavity is small and there is no oozing, the cut edges of the peritonæum should be drawn together by a continuous silk ligature. If, however, there is much oozing, the edges of the cyst should be secured to the lower part of the abdominal wound and its interior packed with gauze strips. Sometimes it is found that the cyst is so firmly attached to important structures that its removal becomes an impossibility. The edges of the cyst and the capsule must then be attached to the abdominal wound and the cavity drained. Such a procedure is not entirely satisfactory, as the cyst is likely to refill later. When intra-ligamentary growths occur on both sides, Dr. Kelly considers that it is easier and better to remove uterus and tumours together, the method adopted being practically the same as that employed by him for hysterectomy.

Incomplete Ovariotomy.—The surgeon may be compelled, very early in the case, to abandon his operation. This will be rendered necessary by the following conditions:—(1) When the tumour is malignant and has infiltrated tissues which cannot be safely removed, or when secondary nodules are found in the abdominal cavity. (2) When the peritonæum is found covered with papillary growths, the result of infection from a papillary cyst. Dr. H. A. Kelly (*loc. supra cit.*, vol. ii. p. 294) advises removal of the mother-tumour whenever it is possible, as he considers it not only relieves the pressure of the ascites, but checks the rapidity of the growth. Moreover, cases have been recorded by Mr. K. Thornton and others where a disappearance of the secondary papillary growths and a freedom from recurrence have resulted from this line of treatment. (3) When the base of the cyst, whether intra-ligamentary or not, is irremovable, deep in the pelvis and adherent to the ureters, large vessels, or adjacent viscera. The surgeon must then empty the cyst of its contents, and suture its cut edge to [illegible] abdominal incision, all superfluous portions of the cyst being cut away. Before doing this he must check all hæmorrhage, inspect any possibly damaged viscera, and carefully cleanse the back of the tumour and the parts behind it. The remains of the cyst, after being carefully sutured to the lower part of the abdominal incision so as to entirely shut off the peritonæal cavity, should be packed with iodoform gauze. When the cyst contains solid growth an attempt should be made to remove this from the portion of cyst left behind, else, as Mr. Doran points out, both sepsis and recurrence will be very probable.

Accidents during Ovariotomy.

(1) *Syncope.*—This appears to be brought about in some cases by too rapid emptying of large cysts. The pressure on the abdominal vessels is relaxed, and they become filled with blood at the expense of the rest of the body. This accident should be avoided by slowly drawing off the contents of large cysts. When it occurs it should be treated by lowering the head, keeping the patient warm, and administering brandy subcutaneously.

(2) *Vomiting.*—This chiefly harasses by straining the intestines out of the abdomen. If prolonged, the operation must be completed as soon as possible, an assistant keeping the viscera in place with a flat sponge or gauze pad.

(3) *Separation of the Parietal Peritonæum.*—It has already been pointed out that this is due to the operator mistaking the subperitonæal fat for omentum. It is an accident that may be avoided by care.

(4) *Rupture of the Cyst.*—This accident may be expected when the walls are thin, necrotic, or softened by recent inflammation. In such cases the cyst should be carefully handled, suspicious spots being kept well out of the wound or packed around with sponges. If rupture occurs the abdomen should be well irrigated with warm boiled water, and if the contents of the cyst are suppurating, drained subsequently.

(5) *Injuries to Viscera.*—Of these the bladder, small intestines, rectum, and ureter are most likely to suffer. The bladder may be injured during the abdominal incision owing to its being drawn up. This, however, is not so likely to happen as in operations for fibroids. Or it may be opened in the course of removal of the tumour. Treatment consists in immediate suture of the organ, and subsequent drainage by catheter to prevent distension. The intestine is most likely to be injured in the separation of adhesions. When possible the wound in the bowel should be at once sutured. If the damage is more extensive the question of resection of a portion of gut will arise. The rectum is sometimes torn in the separation of firm adhesions in the pelvis. The operator should attempt to sew up the rent, a proceeding that will be much facilitated by the raised-pelvis position and a good light. Often, suturing will be found to be impossible, and in such case the neighbourhood of the injury should be well packed with iodoform gauze, the ends of which are left out of the abdominal wound. Sloughing of the bowel sometimes occurs after the operation, leading to the formation of a fæcal fistula. This is owing in some cases to injury of the intestine during the operation, in others to the pressure of the glass tube used for drainage. For the treatment of cases in which the ureter is injured the chapter on that subject should be consulted (p. 170).

(6) *Severe Hæmorrhage.*—It has already been mentioned

or fatal hæmorrhage from injury to large pelvic vessels is rare. Very severe and even alarming hæmorrhage may, however, take place from the cyst wall or its interior. This is especially likely to happen when the solid contents of a papillary cyst are being scooped out by the hand. If the pedicle can be got at readily and ligatured, this should be quickly done. If not, the advice given by Dr. H. A. Kelly (*loc. supra cit.*, p. 296) should be followed. "The only safe plan is to control at once the main vessels going to the tumour by applying artery forceps to the broad ligament at the pelvic brim so as to catch the ovarian vessels, and one or two pairs at the uterine corner to catch the uterine vessels."

(7) *Leaving in Instruments.—E.g.*, sponge or forceps. The fact that this accident has occurred with operators of the largest experience should make all careful. It is best met by having a sufficient definite number to begin with, counting carefully afterwards, and allowing no tearing of sponges.

After-treatment.—The patient should be kept on her back for two days after the operation, and a pillow placed under her knees. At the end of that time she may be turned first on to one side then on to the other. If a glass drainage-tube is made use of, she must be kept on her back till the tube is removed. The most careful attention should be paid to the bedding under her, and the nurse should see that there are no creases in the mackintosh or sheets. A few wrinkles will cause the patient the most acute discomfort.

The retching and vomiting that patients suffer from after an abdominal operation is considerably more than the anæsthetic alone will account for. Drugs should not be employed to combat the sickness. In fact, they will generally be found to be useless. The proper treatment of the stomach is rest during the first twenty hours. The only thing that should be given during this time is hot water, and of this a tablespoonful may be taken at a time as hot as can be borne comfortably. This will be found to be most acceptable to the patient, reviving her, and often removing the feeling of faintness. Ice should not be given either for the sickness or to allay thirst. The iced water remains unabsorbed in the stomach, and is sooner or later rejected. At the end of twenty-four hours small quantities of nourishment may usually be given. It is difficult to lay down rules with regard to quantities. In a straightforward case two drachms of milk, which has been peptonised beforehand, may be given every half-hour to commence with, and the quantity increased to two ounces every hour at the end of two days. Albumen water, made by dissolving the white of an egg in half a pint of water, may be usefully given, mixed in equal quantities with the milk. If vomiting is persistent, enough water should be given to keep the mouth moist, and the patient fed with nutrient enemata and suppositories, given alternately every four hours. In slighter cases of vomiting albumen water alone is often well tolerated.

The bowels should be opened about the third day. This is best effected by means of an oil enema given on the morning of the third day, followed later by a soap and water one, or else two or three grains of calomel may be administered on the evening of the second day, followed by a saline purge the next morning. The unloading of the bowels will, as a rule, make the patient more comfortable, relieve flatulence from which she may have been suffering, and allow her to take more nourishment. The patient should be allowed and encouraged to pass her water naturally after the operation. If she cannot do so a catheter should be passed at the end of twelve hours, every possible precaution being taken to prevent infection of the bladder.

The routine use of opium in any form is to be avoided. On this subject I cannot do better than quote the late Mr. Greig Smith's words: "All medicines are, if possible, to be avoided, particularly opium. Pain I believe to be not so strong an indication for opium as restlessness. Sickness and tympanites are predisposed to, if not often caused by opium. One expects, after the first dose has been administered, to see the patient wake up in the morning with a dry tongue, increased thirst, and some feeling of nausea, which during the day do not pass off, but culminate in restlessness at night, requiring the administration of a second dose. We rarely see a case treated throughout with a perfectly flat or retracted abdomen if opium has been administered. When the patient tosses about in bed, fidgety and restless, without any particular symptoms beyond those incident to a serious operation, opium is undoubtedly of great value."—(*Abdom. Surg.*, 1896, vol. i. p. 210.)

REMOVAL OF THE UTERINE APPENDAGES.*

Indications.†—Before giving these, I would state that there is no operation in which it is more necessary to consider each case on its own bearings, to explain the object and results with honourable carefulness to the friends and, whenever possible, to the patient herself, and to remember that this is above all one of those operations which should never be entertained if there are any honest doubts as to the patient's health being really impaired beyond the aid of other treatment, and the impossibility of otherwise restoring her to usefulness in the position of life in which she has been placed; and that it is an operation which may concern the happiness of another besides that of

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[*] This term has been used here for convenience' sake, as more comprehensive than "oophorectomy," &c.

[†] A paper read some years ago at one of our medical societies, and the discussion thereon, has brought this matter prominently before the profession. I would strongly advise my younger readers to study carefully a very weighty letter in the journals of February 7, 1891, bearing the well-known signatures of Sir John Williams and Dr. Champneys. Every sentence will well repay perusal. I quote a few: "Perimetritis is probably the very commonest of all the serious diseases of women. It is also perfectly certain that the great majority of cases get quite well without any operation. We are far from denying that exceptional cases call for surgical procedures, or that cases of prolonged suppuration in the pelvis are properly treated by the application to them of ordinary surgical principles. But this wholesale resort to a mutilating operation, advocated by several speakers at these discussions, calls for serious consideration by the profession. . . . A plea for patience is to be found in the declaration of the operators that the full benefits of the operation are not felt for months or years after. If the operator would exercise this patience before the operation, there might be less need for its exercise by the patient after the operation."

the patient. Due weight must be given to the large part played by neuroses in this matter, and to the fact that till we have carefully published cases in which the results have been submitted to the only true test, that of time, we shall not be in a position to decide how far the after-condition of a great number of the patients who have been submitted to this operation, is one of improvement. Finally, it is always to be remembered that it is an operation which has been greatly misused.

The following is a limited list of indications for removal of the uterine appendages:

(1) **Diseases of the Fallopian Tubes and Ovaries.**—Of these, the inflammatory affections concern us chiefly, in the form of salpingitis, pyo-, hydro-, or hæmato-salpinx, ovaritis, ovarian abscess, or tubo-ovarian abscess. Other diseases include ovarian new growths which have been considered under the heading of ovariotomy and tumours of the Fallopian tube, which do not call for separate treatment. It is not easy to make rules for guidance that will apply to all cases of inflammation of the appendages. Every case demands careful consideration on its own merits. The broad lines of treatment may, nevertheless, be indicated; they are not unlike those that guide us in the treatment of appendicitis. In the following indications, Mr. Cullingworth (*Syst. of Gyn.*, Allbutt and Playfair, 1896, p. 514) is closely followed:

(*a*) *Operation during Acute Attack.*—It is not often that surgical interference is called for during an acute attack. The difficulty, and more especially the danger, of the operation is increased during this stage. Moreover, the advisability of treating the inflammation, when acute, by rest is shown by the generally good results obtained. Even if pus is suspected, the surgeon should not be in too great a hurry to operate. One well-defined indication for interference during the acute attack has been laid stress on by Mr. Cullingworth, and that is the accumulation of fluid, more especially if it be purulent, in sufficient amount to distend Douglas's pouch and encroach on the vagina and rectum. Here, "there can be no hesitation as to the propriety of making an opening through the vaginal roof. Such timely interference will not only afford immediate relief to the more urgent symptoms, but will prevent the bursting of an abscess into the rectum."

(*b*) *Recurrent Attacks.*—A history of recurrent attacks of peritonitis almost invariably means the presence of pus. If, with this history, the patient has a swelling which has "attained such dimensions as to make it fairly certain that in the midst of it there is either an occluded and distended Fallopian tube, or an ovary enlarged by cystic growth, the indications for the removal of the disease are perfectly clear."

(*c*) The *class of life* to which the patient belongs must be considered. A woman who has to earn her living cannot afford to submit to prolonged treatment by rest, if by operation she can secure a more rapid recovery.

(*d*) *Persistence of Symptoms after Acute Attack.*—In most cases, with rest and appropriate treatment, the inflammatory mass subsides, the pain disappears, and the patient is restored to health. It occasionally happens, however, that the symptoms persist, and unless some relief is afforded the patient, there is danger that she will drift into a condition of chronic invalidism, and become unfit for any of the ordinary vocations of life. These cases present many points of difficulty, and the treatment to be adopted must depend upon the existing condition. Should it be found that the inflammatory mass, instead of subsiding, persists, the advisability of operating will have to be considered. But before resorting to an operation that involves removal of tubes and ovaries, the question of how long expectant treatment should be persevered in, presents itself. The class of life of the patient, as a factor to be taken into consideration, has already been mentioned. Mr. Herman, in answering this question, gives the following practical advice:—

"Most cases will get well within two months; but I have seen expectant treatment followed out for two months without relief, and then the patient has begun to improve. I therefore think that three months is the minimum which in doubtful cases should be considered a fair trial of expectant treatment. This is only a statement as to most cases, not a rule to be applied to every case" (*Diseases of Women*, p. 240). On the other hand, the inflammatory mass may have subsided as the result of treatment, but pain persists, and we find on examination that the pelvic organs are displaced and fixed by adhesions. Under these circumstances greater patience must be exercised, and the necessity for removal of the appendages most carefully considered before such a method of treatment is adopted. In some of these cases a conservative operation may be advantageously practised, and proceedings limited to thorough freeing of adhesions and fixation of the organs in better position. And, lastly, we meet with cases in which the pain does not appear to have sufficient physical basis to justify us in recommending any operation.

(2) **Fibro-myoma of the Uterus.**—Oophorectomy no longer occupies the position it did in the treatment of fibroids; its place has been taken by hysterectomy, and there are several reasons for this. The removal of the ovaries is not followed by uniformly satisfactory results, though, as Mr. Doran points out, we can never feel sure, in cases of failure, that all the ovarian tissue has been removed. As, however, some fibroids may go on growing and may require hysterectomy after the menopause, it is only natural to suppose that a similar result may follow the induction of an artificial menopause. Another disadvantage of oophorectomy is that the patient is left with a tumour which, diminishing in size slowly, may have time to exercise injurious pressure on neighbouring organs. It seems reasonable, moreover, to suppose that a patient with both her ovaries, and without a uterus, is in a better position than one possessing a uterus enlarged by fibroids and no ovaries; and such evidence as we possess at present points to the justice of this conclusion.

Removal of the ovaries is by no means an easy operation in all cases. When the tumour is large the operator will find it often difficult, and occasionally impossible, to remove the ovaries, more especially when the tumour grows into the broad ligament.

There are three conditions which, considered separately or together, may influence us in the choice of oophorectomy rather than hysterectomy. The most important is the general condition of the patient. If this is such as to militate against a prolonged operation, oophorectomy should be chosen, provided that the ovaries can be readily got at and completely removed. When, from the nature and situation of the tumour, it is thought that the risks of removal are unusually great, removal of the ovaries may be chosen in preference to that of the uterus. There would be less hesitation in removing the ovaries if the patient were near the menopause, though it should be remembered that this is often delayed till after fifty years of age. Age alone does not often determine the choice of operation, but, taken in conjunction with the condition of the patient or the character of the tumour, it is a factor to be borne in mind. In those cases in which the tumour gives trouble after the menopause, and an operation is called for, removal of the ovaries would, naturally, not be chosen.

(3) **Dysmenorrhœa and various Neuroses.**—Oophorectomy for dysmenorrhœa has been attended by such disappointing results that the greatest hesitation should be adopted in suggesting its performance or carrying it out. Practically the only cases in which removal of the ovaries for severe menstrual pain should be entertained are those in which the pain may reasonably be ascribed to some lesion affecting these organs. In some of these cases the ovaries are the seat of chronic ovaritis, occasionally accompanied by definite inflammation of the tubes. When with such a condition the patient has intolerable monthly pain, which has resisted all attempts at treatment by rest and drugs, and when, as Dr. Griffiths points out (*Syst. Gyn.*, Allbutt and Playfair, p. 864), the suffering is not out of all proportion to the ascertained lesions, removal of the inflamed ovaries will have to be considered. Whilst this operation may relieve the local symptoms, the general nervous symptoms from which these patients suffer very often persist, or become intensified, and may prove as grave a source of trouble as the original pain. A very necessary note of warning has been sounded by Mr. Bland Sutton, Dr. Howard Kelly, and others, with regard to the diagnosis of oophoritis. The ovary may normally contain large Graafian follicles, and the presence of these does not constitute oophoritis. A cystic ovary, the result of inflammation, is considerably larger than normal, with a thickened tunica albuginea, and a stroma that is more fibrous and denser than normal. With regard to other neuroses, such as hysteria, epilepsy, and insanity, experience has shown us that the removal of the ovaries for this condition is not justified by the results obtained. On this subject Mr. Bland Sutton's remarks are worth careful attention:

"The removal of the ovaries and tubes has been recommended and practised for the relief of such conditions as (1) Epilepsy and insanity; (2) Dysmenorrhœa; (3) Ovarian neuralgia. In this group the procedure has not been followed by encouraging results; indeed, they are so unsatisfactory, that those who have had the greatest experience in this class of surgery are almost unanimous in condemning the operation, save under very exceptional conditions: even then the operator should safeguard himself by seeking confirmatory opinion. The chief objections are summarised in the following clauses: (1) In a very large proportion of cases the removal of the ovaries and tubes fails to relieve the patient. (2) In many cases the operation aggravates the symptoms. (3) Many cases, reported a few weeks or months after the operation, have subsequently relapsed. . . . . In many instances where oophorectomy has been carried out for relief of pain, unaccompanied by objective signs in the pelvic viscera, the operators have pointed out, in justification of the interference, that the ovaries were cystic. . . . . Such men . . . . when they excise an ovary for pain, cut into the organ, and, finding ripe follicles, describe it as a cystic ovary. Every normal ovary is cystic, hence an excuse is readily found." Even when some definite lesion exists the results have not proved satisfactory. Writing of epilepsy, Dr. Weir Mitchell (quoted by Dr. H. Kelly, *loc. cit.*, vol. ii. p. 194) says: "In no case seen by me had ablation of the ovaries and termination of menstruation cured epilepsy. I have never sanctioned such operations where the appendages were sound. I have agreed thrice to these operations in epilepsy with such pelvic disease as of itself would justify oophorectomy. In all three, after some delay, the fits returned, and were in no way permanently aided."

(4) **Osteomalacia.**—The removal of the ovaries in the treatment of this disease has been performed a number of times since it was suggested by Professor Fehling, of Bâle, in 1887, and appears to have met with signal success, the course of the disease being arrested and the patients restored to active life (Bland Sutton, *loc. supra cit.*, p. 384).

(5) **Inoperable Cancer of the Breast.**—The question of oophorectomy of this condition has already been considered in Vol. i. p. 683.

The Operation.

(1) **When Appendages are not Inflamed or Adherent.**—The preparation of the patient, operating-room, &c., is similar to that already described for ovariotomy. An incision of about two inches is made in the median line, and carried down to within an inch of the pubes. The different structures of the abdominal wall are divided until the peritonæum is reached. This is then picked up by a pair of forceps, and, care being taken that intestine is not included in the grasp of the forceps, is divided horizontally. The peritonæum is then incised for the length of the incision on two fingers used as a director. Two fingers are now inserted into the abdominal cavity and seek the fundus uteri. From this starting-point they are passed along one or other broad ligament, and seize the corresponding Fallopian tube and ovary, which are then drawn out of the wound. With a blunt pedicle needle a double ligature is passed through the broad ligament, and the loop of the ligature being divided, the two strands are interlocked. One ligature is carried round the tube close to its uterine attachment and tied firmly, and the other one is tied over the free edge of the broad ligament. Whilst the ligatures are being tightened the traction on the appendages should be relaxed. A pair of Spencer Wells's forceps are then applied just beyond the ligature, and the ovary and tube cut away. The application of the forceps enables the operator to carefully inspect the stump for hæmorrhage before allowing it to fall back into the abdominal cavity. The other side having been treated in a similar way the abdominal wound is sutured. It is not necessary to wash out the peritonæal cavity or to drain.

It has been objected to this mode of tying the broad ligament that it puts tension on it, and drags together its pelvic and uterine ends, so leading to the risk of the ligature slipping, with consequent hæmorrhage. Dr. H. Kelly (*Oper. Gyn.*, vol. ii. p. 198) therefore recommends that the uterine and ovarian vessels should be tied separately. "The first ligature includes the ovarian veins and artery, and is passed through the clear space in the broad ligament and tied near the pelvic brim over the top of the infundibulo-pelvic ligament, well beyond the fimbriated end of the tube. A second ligature is applied to the utero-ovarian ligament posteriorly. A third ligature is passed over the top of the broad ligament at the cornu uteri, embracing the uterine vessels which are visible and the isthmus of the tube." Any bleeding points in the cut edge of the broad ligament are seized with forceps and tied. A longer incision will be required when oophorectomy is performed for fibroids. There may be considerable difficulty in removing the appendages, and in those cases in which the fibroid grows into the broad ligament, spreading out the mesovarium, it may be impossible to apply a ligature between the ovary and tumour.

(2) **Removal of Appendages when they are Inflamed and Adherent.**

This is an operation that may present very grave difficulties in its carrying out. There are two routes by which the removal of the appendages may be effected—the abdominal and the vaginal. Of these the former, besides being the older, is the preferable form of operation. The latter is only suitable to those cases in which the adhesions are not dense and in which extensive fixation to the abdominal viscera does not occur. And as it is extremely difficult to estimate beforehand the character and the extent of the adhesions, the operator had better confine himself to the abdominal route rather than run the risk of having to open the abdomen to complete an operation that was found impracticable from the vagina.

In dealing with the adhesions the late Mr. Lawson Tait considered it best to depend entirely upon the sense of touch; and he has been followed in this teaching by many surgeons. The operation is carried out through a comparatively small abdominal incision, and the sense of touch is relied on entirely in guarding the operator from the infliction of injury whilst separating the tubes from adherent structures. The operation will, however, be much facilitated for those with less experience, by bringing into play not only the sense of touch but that of sight. For this purpose the patient should be placed in the Trendelenberg position as affording a better view of the pelvic viscera.

Abdominal Incision.—The patient being in this position, an incision about four inches long is made in the median line and carried well down to the pubes. The steps of this part of the operation are similar to those described in ovariotomy. On reaching the peritonæum care must be taken in opening the abdominal cavity, and the operator should bear in mind the possibility of adhesions existing between the omentum or intestines and the wall. The peritonæum is picked up and rolled between the finger and thumb, and the absence of adhesions being noted is incised, when the viscera at once falls away from the parietes. Omentum or intestines found adherent to the abdominal wall must be carefully separated by means of the fingers.

Adhesions.—The condition existing should then be carefully ascertained, and the first thing likely to demand attention is adherent omentum. This is frequently found covering in and adherent to the pelvic viscera, and it may also be much thickened by inflammation. It should be freed carefully from its attachments to the pelvic organs with the fingers, care being taken not to injure intestines or bladder. Any bleeding points should be at once secured. If much difficulty exists in freeing the omentum or in determining its exact relationship to other parts, it had better be ligatured and divided, the lower attached portion being dealt with later. In any case it is better to ligature and remove portions of omentum much thickened by inflammatory changes. If intestines are adherent they must be separated with great care, and it is in this stage of the operation that the Trendelenberg posture will be found of great assistance. The bowel, more especially after the separation of firm adhesions, should be carefully inspected, and any damage to the walls at once repaired. All adhesions existing between the intestines and omentum on the one hand, and the pelvic viscera on the other, having been freed, the abdominal organs are pushed back towards the diaphragm and maintained in position with a large flat sponge or gauze pad. There may be some difficulty in doing so if the abdominal walls are rigid and the patient not fully under the anæsthetic. A little patience, however, will, as a rule, allow of the viscera being pushed up out of the way, so as to enable the operator to obtain a view of the pelvic contents.

Enucleation of Appendages.—The operator is now in a position to set about freeing the adherent appendages. As far as is possible the condition present is ascertained by sense of sight as well as that of touch, the position of the uterus located, and the extent and fixity of the mass, formed by one or both appendages, noted. The matted tube and ovary forms a tumour lying to the back of the uterus and broad ligament in the lateral fossa or Douglas's pouch, and the broad ligament is drawn over the front of the mass. The first step in enucleation is the separation of the mass from its posterior connections and from the opposite appendages, if inflamed. To effect this, the hand, with the palmar surface forward, is passed down in the hollow of the sacrum behind the mass, carefully separating with the tips of the fingers the adhesions that fix it in this situation. Mr. Cullingworth considers that at this stage it is often desirable for an assistant to pass a forefinger into the rectum to serve as a guide. Working down in this way the lower part of the mass is reached. The next step is its separation from the back of the broad ligament to which it is fixed, and which effectually prevents the tube being drawn up into the wound. Enucleation is consequently continued from below upwards with the tips of the fingers inserted between the mass and the back of the broad ligament. In this way it is gradually freed from all its connections.

Removal of Diseased Parts.—The affected parts are now drawn well up through the abdominal incision, and a suitable point in the broad ligament chosen for transfixion. A blunt pedicle needle with a double ligature is then passed through the broad ligament, and the loop divided. The two strands are interlocked where they pass through the broad ligament to prevent the tearing apart of this structure, when they are tied. Each ligature is then tied separately, one round the Fallopian tube close to the uterine cornu, the other round the free upper border of the broad ligament, and, a pair of forceps being applied to the tube just beyond the ligature, the diseased parts are cut away. Or the method of Dr. H. Kelly described above, which presents some advantages, may be employed.

The cut end of the tube held in the forceps is next brought into view and carefully wiped with 1–1000 perchloride of mercury solution, or else cauterised with Paquelin's cautery to obviate the risk of subsequent infection from the cut end. Before allowing the stump to fall back into the pelvis, the parts are carefully examined for bleeding points, which should be seized with forceps or else under-run. Care should be exercised in the application of forceps in the pelvis lest a portion of the rectal wall be nipped, and its vitality so affected that it subsequently sloughs.

Treatment of Tube when Distended.—If the tube is found to be distended with pus or other fluid, it is better, if possible, to remove it without previously emptying it. This is recommended on account of the greater ease of dealing with a distended tube than one empty and collapsed. Greater care must, however, be exercised in the separation of adhesions, and the parts packed round with gauze or sponges to prevent, as far as possible, the spread of infective material if the tube ruptures, as it may very possibly do in the course of manipulation. Should rupture occur the fluid must be removed as rapidly as possible, all infected sponges and swabs taken away, and the parts thoroughly cleansed.

Hæmorrhage.—Oozing from large raw surfaces is sometimes free, but generally yields to pressure exercised by sponges in the course of the operation. Should it still persist, and no obvious bleeding point be visible at the end of the operation, the pelvis should be packed firmly with strips of gauze, the ends of which are left out of the lower parts of the abdominal incision. The strips should be removed at the end of twenty-four hours. This is preferable to the employment of the cautery or perchloride of iron. Bleeding to such an extent as to be alarming is, when it occurs, most likely to be due to injury to the broad ligament and its vessels in the separation of the tube from its posterior surface. A search may be made for the vessel with the patient's pelvis raised and a good light. This, however, will be found to be most difficult, and will very likely be unsuccessful. The advice given in Dr. Baldy's *Gynæcology* (1894, p. 509) to secure the ovarian and terminal branches of the uterine artery by passing a threaded needle through the broad ligament close to the pelvic wall, and a second one through the broad ligament near the uterine cornu, appears to be worthy of trial under these circumstances.

Drainage will be called for more often in the case of pelvic inflammation than of ovarian tumours. The following may be regarded as indications for its employment:

(1) When large raw surfaces have been left after the separation of extensive adhesions, and it is thought that the amount of exudation likely to be poured out is more than the damaged peritonæum can deal with.

(2) When, in the course of removal, a pyo-salpinx, or abscess-cavity, has ruptured and soiled surrounding parts.

(3) When the bowel has been injured in the course of the operation. Damage to the small intestine can generally be repaired without risk of subsequent leakage. Injury to the rectum cannot be so readily dealt with, and it may be impossible for the operator to gain such access to the damaged parts as will enable him to repair the lesion.

To prevent general infection of the peritonæal cavity, as the result of leakage from the bowel, he will have to depend on careful gauze packing.

(4) When the operation is incomplete. Firmness of adhesions and danger of injury to viscera will sometimes lead the surgeon to leave his operation unfinished, rather than subject his patient to unusual risk. He has probably exposed, in the course of his manipulations, infected areas, such as a pyo-salpinx or a pelvic abscess. Under these circumstances he will remove such diseased structures as is found possible, and provide free drainage by means of gauze strips for the infected parts left behind.

Conservative Surgery.—By this term is meant the preservation of such organs or parts of organs as are not diseased or not beyond the power of recovery. This, which is the general principle underlying all true surgery, receives special significance in its application to the pelvic organs, on account of the importance of the latter in securing the happiness and well-being of the individual. This applies more especially to the ovaries, which are not only essential to the functions of menstruation and child-bearing, but which exercise—probably by means of some internal secretion—a wide influence over nutritive processes in general. That every effort should be made to preserve a portion at least of one of these organs is not disputed at the present time; the only question is how far one is justified by one's attempts at conservatism in subjecting the patient to increased risks of recurrence of disease and further operation.

An important step was made in conservative surgery when it was recognised that disease limited to the appendages of one side did not necessarily mean the removal of the organs on both. A further advance was marked by the recognition that certain conditions, which at one time were thought to be pathological, were not diseases at all.

The cystic ovary is a case in point. Though a definite pathological condition does exist in which the ovary is the seat of numerous small cysts, the mere presence of these does not necessarily constitute an abnormal state of the organ, nor do they justify its removal.

A further reason advanced for the practice of conservatism lies in the fact that portions of organs left behind are capable of performing the functions of the entire organ. It has been shown clinically that the stump of an amputated tube may convey an ovum to the uterus, which will then pass through the developmental changes of normal pregnancy (B. F. Baer, *Ann. of Gyn. and Ped.*, Jan. 1894).

Dr. Kelly (*loc. cit.*, p. 188) has recorded a case in which pregnancy followed an operation involving the removal of one tube and the opposite ovary, and where the transmission of the ovum was effected by the tube on the side opposite to that of the ovary. Similar cases have been recorded in which pregnancy has followed operations involving partial removal of the appendages. Whilst such an occurrence may not be very common, the mere fact that it can occur constitutes a further reason for exercising such conservatism as is possible in dealing with the pelvic organs.

The capacity for repair shown by inflamed pelvic organs and the powers of absorption of the peritonæal sac in the case of large in[illegible]matory exudates, is a well-established fact. A similar course is known to all surgeons in the case of the vermiform appendix. This power of regeneration is a point telling in two ways; for whilst it will encourage the operator to sacrifice as little as possible of the organs he is dealing with, it is also an argument in favour of rest and expectant treatment.

There are certain conditions other than disease of the tubes and ovaries demanding operation in which there can be no doubt as to the advisability of leaving the ovaries or as much of them as can be safely preserved. Hysterectomy for fibroids is a case in point, where one or both ovaries should be left when possible. A further example is seen in parovarian cysts, which may be shelled out sometimes from the broad ligament without sacrificing tube or ovary.

When we come to disease of the ovary itself, it is especially in non-inflammatory affections that an attempt may be made to save a portion of the organ. Such conditions as cysts due to enlargement of Graafian follicles or corpora lutea may be dealt with on this principle—the cyst being shelled out or a wedge-shaped portion of the ovary being removed. In the case of dermoids and the cystomata the ovarian tissue is, as a rule. so involved that an attempt to save a part of it will not often be found possible. Even when, as occasionally happens, some of the ovarian tissue remains unaffected, the advisability of trying to preserve it is open to question on account of the risk of leaving behind sufficient of the tumour to lead to a recurrence. Nor does it seem improbable that the remaining portion of ovary is liable to a similar cystic change. The chief justification for saving a part of the organ would be in the fact that the opposite ovary either required removal or had already been removed.

It is in dealing with inflammatory conditions of the appendages that the widest difference of opinion with regard to conservatism exists. It was the practice at one time, if the appendages on one side were diseased, to remove those on the other side, even if found healthy. This was done more especially in those cases in which the tubes were the seat of suppuration. The late Mr. Greig Smith (*Syst. of Gyn.*, Allbutt and Playfair. p. 910) said: "The removal of the appendages on one side only for suppurative disease was tried by Tait, but given up on account of the large number of recurrences or relapses. Other surgeons have had similar experiences; and the rule in all cases of suppurative diseases of the appendages now is that if one set is removed so also should be the other."

In spite of the risks of recurrence, modern opinion inclines strongly to the preservation of healthy appendages, and, as the interior of the uterus is the source of infection in most cases, the more rational treatment is to attend carefully to this, and thus prevent the extension of inflammation, so far as is possible, to the sound appendages. Before deciding to leave them they should be carefully examined. Should pus be found to exude from the end of the tube, it should be removed. Such a high authority as Dr. Howard Kelly (*loc. cit.*, vol. ii. p. 186) recommends that under certain circumstances the contents of the tube should be squeezed out and its interior washed out with saline solution. and then sterilised with 1 in 5000 corrosive sublimate solution. It is difficult to believe that the tube can be effectually sterilised in this way, and its preservation would seem to invite reinfection of the peritonæal cavity. Until more evidence is forthcoming with regard to this procedure it appears unsafe to recommend it for general adoption. On the subject of adhesions, Dr. Kelly has laid it down as a rule that these do not in themselves constitute a reason for the removal of organs. The mere presence of adhesions does not imply that the organs are beyond the power of recovery, and, in fact, there is plenty of clinical evidence to the contrary. It has already been mentioned that in some cases the persistence of symptoms is due rather to adhesions binding down the pelvic organs in abnormal positions than to the presence of any source of inflammation. Under these circumstances, operative proceedings may be limited to the separation of adhesions and the fixation of organs in better position. Dr. Kelly has laid stress on the importance of not only freeing the organs from surrounding parts, but also of liberating any kinks in the tube, a condition that may render the patient liable to tubal pregnancy.

Whilst treatment limited to the freeing of organs may be followed in those cases in which the inflammation has subsided, it should not be adopted when they are still inflamed. The separation of adhesions without removal of the cause is certain to be followed by the formation of fresh ones, besides breaking down the barrier that limits the spread of infection.

The question may arise as to whether the Fallopian tube should be preserved when removal of the corresponding ovary is found necessary.

In inflammatory conditions of the appendages, it is uncommon to find a case in which the ovary requires removal and the tube is found in a healthy state. Moreover, the tube is useless without the ovary, and, as the late Mr. Greig Smith has pointed out, the removal of the latter will probably cause kinking of the tube. Consequently, if the ovary is removed, it is usually safer to remove the tube also (*loc. supra cit.*, p. 909). It might be left if operative measures have resulted in the preservation of the opposite ovary, but removal of the corresponding tube. In Dr. Kelly's case, quoted above, pregnancy followed such an operation, leaving one ovary and the opposite tube.

Those conditions have been pointed out in which the practice of conservative surgery may be safely advised. But there are certain operations more open to debate, such as the washing out of tubes containing pus, the amputation or resection of diseased tubes, and the opening of closed tubes. In the hands of the chief advocates of conservatism these procedures have met with results that may be regarded as encouraging, but, with our present information, they are not operations that can be recommended for general adoption.

CHAPTER XVII.

OPERATIONS ON THE UTERUS.

REMOVAL OF MYOMATOUS UTERUS BY ABDOMINAL SECTION.—CANCER OF THE UTERUS.—REMOVAL OF A CANCEROUS UTERUS BY ABDOMINAL SECTION.—REMOVAL OF A CANCEROUS UTERUS PER VAGINAM. — CÆSARIAN SECTION. — PORRO'S OPERATION. — ECTOPIC GESTATION.

REMOVAL OF MYOMATOUS UTERUS BY ABDOMINAL SECTION.

Indications for Operation.—A fibroid tumour of the uterus does not by its presence merely afford a sufficient indication for operation. It must either give rise to symptoms which threaten life, or be a source of such discomfort from its size or position as to prevent a patient enjoying a reasonably comfortable existence or earning a livelihood. The following is a list of indications that justify removal of a myomatous uterus:—

(1) **Hæmorrhage.**—Profuse hæmorrhage at the menstrual periods is the symptom that is the commonest, and that most often necessitates a patient seeking advice. The amount lost, and its effect on the patient's health, the influence of drugs and general treatment, the age of the patient, are all factors to be taken into consideration. The favourable influence that the change of life often has on these tumours should be borne in mind, and if a patient is nearing the menopause it may be advisable to recommend her to wait a year or two. The fact that it is generally postponed, and often deferred till after fifty years of age, should be remembered, and if the hæmorrhage is very profuse, leading to profound anæmia, and very little relief is afforded by milder measures of treatment, the advisability of a radical operation should be put before the patient.

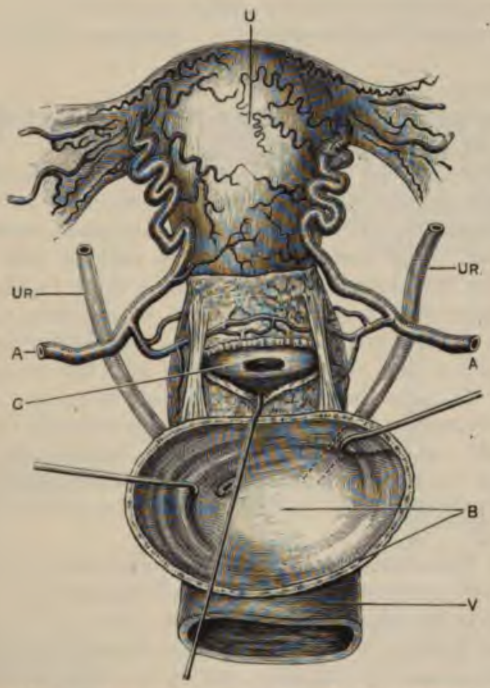
(2) **Pressure Symptoms.**—These are most marked in the case of medium-sized tumours impacted in the pelvis. The most common symptom is frequent or difficult micturition. There may also be trouble in keeping the bowels open, owing to pressure on the rectum.

Or, the ureters may be pressed on, and hydro-nephrosis or pyelonephritis result. These symptoms are most marked just before the onset of the menstrual flow, when the tumour is swollen as a consequence of the natural engorgement of the organs.

Pain in association with fibroids is due not only to pressure on nerves and neighbouring organs, but also to attacks of peritonitis and inflammation of appendages. Dr. Kelly draws special "attention to the fact that those myomata which are constantly associated with great pain almost invariably belong to the class of complicated cases in which a tubal or ovarian inflammatory disease will also be found" (*loc. cit.*, vol. ii. p. 367).

(3) **Great Size.**—A large tumour in the abdomen may not necessarily threaten life, but may be a source of grave inconvenience and discomfort. It interferes with the return of blood from the lower limbs, and so causes œdema; it presses on the stomach and impedes digestion; it limits the movements of the diaphragm, and so interferes with respiration; and, by preventing an active existence, leads to a condition of general ill-health. As Mr. Herman (*loc. supra cit.*, p. 822) points out, "these consequences of great bulk not only call for operative cure; unfortunately they do more: they add to its risk. . . . In th

FIG. 214.



Relation of the ureters and uterine arteries to the cervix. (Baldy.)

U, Uterus.
UR, Ureter.
A, Uterine Artery.
C, Cervix.
V, Vagina.
B, Section of bladder.

state of abdominal surgery, the risk to life in the removal even of a big fibroid is small, and the possible undesirable after-consequences are less grave than the constant presence of a great tumour. A well-advised patient will, therefore, welcome relief by operation."

(4) **Rapid Growth of the Tumour.**—If at intervals of a few months the tumour is found to be markedly increasing in size, the question of its removal will have to be considered. Very rapid enlargement is usually due to secondary changes occurring in it, such as œdema, cystic formation, or hæmorrhage. A sarcomatous change will also be responsible for a rapid growth, but is of rare occurrence.

(5) **Complications**—due to associated inflammatory disease of the appendages and peritonæum, tumours of the ovary, cancer of the uterus—will call for operative interference.

There are three methods employed in the removal of a myomatous uterus, in two of which the hysterectomy is partial, in the third total. They are respectively:

(i.) Supra-vaginal hysterectomy; extra-peritonæal treatment of stump.

(ii.) Supra-vaginal hysterectomy; intra-peritonæal treatment of stump.

(iii.) Total hysterectomy.

(i.) Supra-vaginal Hysterectomy. Extra-peritonæal Treatment of Stump.

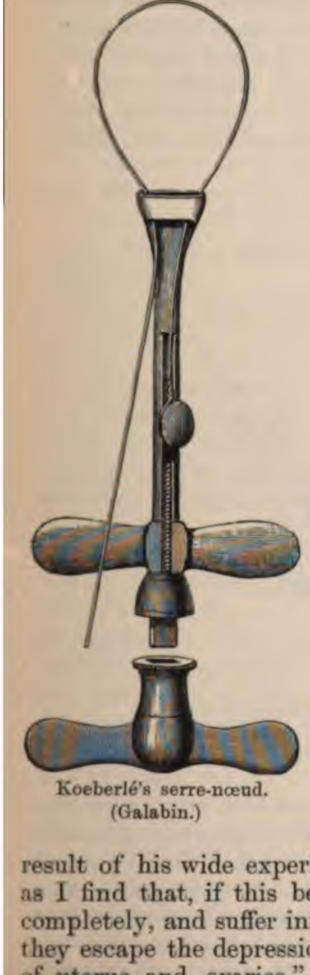
Incision.—The patient having been prepared as for ovariotomy, an incision is made in the median line, proportionate to the size of the tumour to be removed. If necessary it is continued upwards to the left of the umbilicus. The incision should be carried well down towards the pubes, as by this means the subsequent steps in the operation are facilitated. Especial care should be taken in dividing the peritonæum, as the bladder is frequently drawn up, and thus rendered liable to injury; moreover, a cut made accidentally into the tumour is likely to lead to very troublesome hæmorrhage difficult to arrest. To avoid these dangers the peritonæum should be pinched up towards the upper part of the incision and carefully examined before being cut through. The opening is then enlarged upwards and downwards on two fingers used as a director, the height to which the bladder ascends being in this way readily detected.

Delivery of Tumour.—A hand is now introduced into the abdomen and the condition present noted. Any adhesions found must be dealt with. These present much more difficulty than in the case of ovariotomy, partly on account of the size of the tumour, and the fact that it cannot be diminished by tapping, partly on account of the bleeding that follows their separation. Mr. Thornton says on the subject of adhesions: "If they are present, especially if they are omental, they often contain enormous vessels, and in separating them great care is required to avoid serious loss from the uterine side after they are tied and divided on the proximal side." He points out that "adhesions of large surfaces of intestine are exceedingly difficult to deal with; there is no room to apply ligatures before separating, and no room, or not firm enough tissue, to apply pressure-forceps after separation; thus both surfaces frequently ooze very freely. . . . Sponge pressure is the only way of dealing with these oozing surfaces" (Allbutt and Playfair, *Syst. of Gyn.*, p. 615).

In the simplest cases the tumour is seized hold of and brought out of the wound, care being taken not to exercise such traction as will result in tearing of its pedicle, an accident that may cause dangerous bleeding. But it sometimes happens that the delivery of the tumour from the abdomen presents great difficulty, and it may be found necessary to divide the broad ligament on one or both sides before this can be effected.

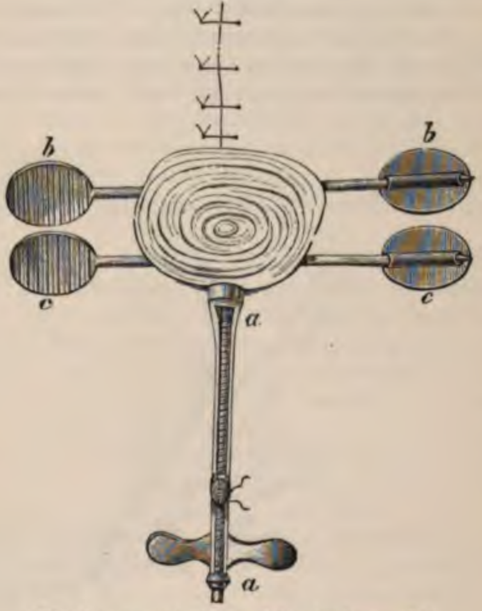
Treatment of Ovaries and Bladder.—Before the ligaments are dealt with the operator must decide whether one or both ovaries shall be preserved. The importance of saving one at least has been referred to in the chapter dealing with the appendages. Mr. Thornton, as the result of his wide experience, says: "I always leave an ovary if I can, as I find that, if this be done, the patients recover more quickly and completely, and suffer infinitely less at the change of life; especially do they escape the depression which is apt to follow the complete removal of uterus and ovaries." If it is found that the ovaries are healthy and that their preservation is feasible, the surgeon proceeds to divide the broad ligaments. The method of dealing with these structures is described in the next section on the intra-peritonæal operation.

FIG. 215.



Koeberlé's serre-nœud.
(Galabin.)

FIG. 216.

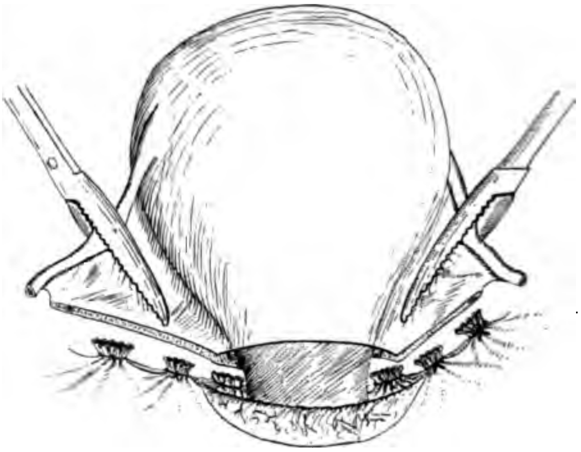


The lower part of the abdominal wound is shown sutured above the stump. *a*, *a*, serre-nœud; *b*, *b*, pin passing nearer the anterior; and *c*, *c*, pin passing nearer the posterior boundaries of the stump. (Doran.)

Whether they have to be ligatured and divided with the tumour in the abdomen, or brought outside it, the details are the same. The next point requiring careful attention is the bladder. The operator must be very careful that this is not included in the rubber or wire ligature. Some surgeons prefer to keep the bladder full, in order to define its limits, but this is not necessary. If any doubt exists as to the height to which this organ extends on the front of the tumour, a sound should be passed. If it ascends over the part to which the constriction is to be applied, it must be reflected from the uterus. To carry this out an incision is made through the peritonæum, from side to side, half an inch above the bladder, and this organ carefully separated by means of the finger from the uterus.

Treatment of Pedicle.—The constriction of the pedicle may be effected either by means of wire or rubber ligature. If the former method is to be made use of. thick, soft iron wire, that will not readily cut through the tissues, should be employed, and the best form of clamp is Koeberlé's serre-nœud. The wire, having been adjusted round the neck of the tumour, is slowly tightened up by means of the clamp. Two transfixion pins are then passed through the pedicle immediately above the wire, and the tumour cut away about an inch above the pins. Instead of wire an elastic rubber ligature may be employed. Professor Hegar used an india-rubber cord five millimetres thick, which by means of a special needle was made to transfix the cervix. The two halves were then tied separately, and the whole cervix encircled by another ligature placed below the two preceding ones. The double ligature does not appear to be necessary, and one rubber ligature drawn round the cervix is sufficient; means being taken to prevent it slipping by grasping the knot in a pair of forceps. There will probably be some shrinkage of the stump as the tumour is cut away, necessitating the tightening up

FIG. 217.



Supra-vaginal hysterectomy. Intra-peritonæal treatment of stump, showing mode of division of broad ligaments and reflection of anterior flap with bladder. Uterine vessels are tied and divided.

of the wire by a few turns of the screw of the clamp. The stump is pared carefully, either now or after closure of the abdominal incision. Mr. Thorburn, to whom so many details of the operation in its present form are due, pares down the stump as much as possible, especially cutting away the inside fibrous and muscular tissue into a somewhat cupped shape. It has been recommended that the peritonæum of the pedicle should be drawn over the cut surface of the stump and sutured there. This is unnecessary, and, as Mr. Thorburn points out, merely serves to enclose materials which are much better escaping into the dressings. The peritonæum of the abdominal wall is now secured to that of the pedicle below the wire by two or three sutures, and the ventral incision closed in the usual way. The stump is powdered with iodoform and dressed with iodoform gauze, care being taken to insert several layers of gauze beneath the pins and the clamp.

After-treatment.—The dressing should, if possible, be left untouched for a few days, one or two turns of the screw being made in the case of large pedicles. The stump is often ready to come away in two or three weeks' time. If it does not then show signs of doing so, it may be clipped down to the wire and pins, and these latter removed altogether. Mr. Thornton recommends that some of the sutures of the abdominal wall should be left longer than usual, as there is a greater tendency to reopening of the wound than in the case of ovariotomy.

ii. Supra-vaginal Hysterectomy. Intra-abdominal Method.

The mode of operation described is, in its essentials, that associated with the name of Dr. Baer,* of Philadelphia. The principles on which he based his operation were: "First, control of hæmorrhage by ligature of the blood-vessels in the broad ligaments; second, non-constriction of the cervical tissues, so that there shall be no cause of suppuration; and third, non-disturbance of the cervical canal, so that sepsis from the vagina may be prevented." Dr. Kelly (*loc. supra cit.*, p. 365) draws attention to the fact that the very important step of systematically securing the ovarian and uterine arteries in their course, as a preliminary to hysterectomy, was devised by Dr. L. A. Stimson, of New York.

The Operation.—The initial stages of the operation are similar to those described in the extra-abdominal method. It will be considerably facilitated in some cases by placing the patient in the Trendelenberg position. The incision having been made through the abdominal wall, the condition of the parts examined and adhesions dealt with, the tumour is delivered as previously described. As in the preceding method, it may be found necessary to deal with the broad ligaments before delivering the tumour, and to divide part of them on one or both sides with the uterus still in the abdomen. The steps of this part of the operation are similar to those taken when the tumour can be brought through the ventral incision.

Division of Broad Ligaments.—The uterus having been drawn out of the abdomen, the operator carefully examines the broad ligaments and appendages on each side, and decides whether he will leave one or both ovaries, or whether he will remove them both. When possible, one at least should be saved, exception being made in those cases in which they are found diseased, or when it is found impossible to leave them, or the patient has reached the menopause. The surgeon, after carefully examining both sides, chooses that which can most easily be dealt with, and, seizing the upper part of the broad ligament, passes through it, at a point free from vessels, a blunt pedicle-needle threaded with No. 3 silk. The exact point of perforation will depend upon whether the ovary is to be removed or not: in the former case the ligature will be carried round the free edge of the broad ligament; in the latter it will include the Fallopian tube.

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* This method of operation was published in the *Transactions of the American Gynæcological Society*, vol. xvii. (1892), p. 234, and vol. xviii. p. 62.

This ligature, which secures the ovarian artery, is then firmly tied, and that portion of the broad ligament next the tumour being secured by means of forceps, the part intervening between the ligature and the forceps is divided (Fig. 217). A second ligature is passed through the broad ligament of the same side, lower down, including the round ligament, and firmly tied; the proximal portion of the broad ligament is clamped, and the part between forceps and ligature divided. In most cases these two ligatures will be found sufficient, but more can be applied in the same way if required. The use of forceps for clamping the proximal part of the ligament, as described above, rather than ligatures, will be found to effect a saving of time. The opposite side is then dealt with in the same way.

Formation of Anterior Flap.—The next step in the operation is the reflection of a flap of peritonæum and the bladder from the front of the uterus. An incision is made through the peritonæum covering the front of the uterus, from side to side, about an inch above the line of attachment of the bladder, the position of which should be carefully ascertained. It should be carried across to join at each extremity the lower end of the cuts in the broad ligaments. The bladder is then separated from the uterus by means of the finger, any firmer bands (and these are met with especially in the median line) being divided with scissors. Care should be taken in this separation, as the bladder is sometimes much thinned by stretching, and it does not require much force to push the finger through into its interior. Should this accident happen, the opening must at once be closed with sutures. A small peritonæal flap may be raised on the posterior surface of the uterus, but this is not necessary, and may quite well be dispensed with. By the reflection of the anterior flap some loose cellular tissue on each side of the neck of the myomatous uterus is exposed, and in this there may be felt pulsating, and sometimes seen, the uterine artery.

Ligature of Uterine Artery.—The position of the artery is now carefully defined on one side, and a silk ligature threaded on a pedicle-needle is passed through the cellular tissue between the artery and the uterus. A pair of Spencer Wells's forceps are now applied so as to include the artery a little above the ligature, and the latter is firmly tied. The tissues, including the uterine artery, are then divided between the ligature below and the forceps above, and if the ligature has been properly applied there will be no bleeding. If the artery has not been secured it will spurt on division, and should be promptly seized with forceps and tied. The same procedure is adopted on the opposite side.

Removal of Uterus.—A point has now been reached at which the blood-supply has been secured, and nothing is left keeping the enlarged uterus in position but the narrow neck below. The only remaining step is to divide this latter. The intestines being kept out of the way, the left hand is passed down behind the neck to prevent the possibility of injury to bowel, and the pedicle is divided with knife or scissors just above the point at which the uterine arteries are secured.

The division of the pedicle is effected in various ways. The simplest method is to make an incision straight through, so as to leave a flat raw surface, which is subsequently covered in by the peritonæal flaps. Dr. Baer, in his original description (*loc. sup. cit.*), considered that in most cases it was sufficient to allow the flaps to fall together over the stump, and that there was no need to suture them. To render the stump completely extra-peritonæal it is better, however, to accurately coapt the cut edges of the peritonæum. This is effected by means of a continuous silk suture. The divided edges of the broad ligament on one side are first sewn together. The anterior flap of peritonæum is then drawn over the stump, and its free border sutured to the cut edge of peritonæum at the back of the stump, the operation being completed by sewing together the two edges of the remaining broad ligament. In defining the principles on which this operation was based, Dr. Baer laid stress on the importance of not disturbing the plug of mucus in the cervical canal, as he regarded this as a bar to the spread of infection. Though in healthy women the interior of the uterus appears to be free from organisms, in some cases of fibroids there is a purulent discharge from the organ, and one objection made to the simple division of the cervix is that infection of the wound may take place from the cervical canal. To prevent this happening, the closure of the canal is recommended by some operators. This may be effected by making the incision through the cervix, V-shaped, and approximating closely the two flaps by sutures. Dr. Kelly prefers to so hollow out the stump as to leave it cup-shaped, the canal being closed by sutures, which are passed from before backwards, and which convert the cup into a transverse linear wound. As a further precaution against infection the canal may be excised with knife and scissors or cauterised. Sutures passing through the cervix are not, however, free from objection, as they may, themselves, become septic, and convey infection to the wound surfaces. Though the closure of the canal has met with admirable results in the hands of some surgeons, it is not regarded with favour by all. Mr. Doran, in opening a discussion on the treatment of fibroids (*Brit. Med. Journ.*, Sept. 15, 1900) did not advocate the closing of the stump by sutures, as he considered this procedure was liable to be followed by sloughing.

Comparison of the Intra- and Extra-peritonæal Methods.—The weak points of the extra-peritonæal method are these:—

(1) The prolonged convalescence, lasting for six or eight weeks, while the slough is separating. After the intra-abdominal method the wound quickly heals, and the patient is able to get up in three or four weeks' time. This is generally held, and I think rightly, to be a great advantage; but Mr. Herman does not consider it to be so great as might be thought, as the nervous shock caused by the operation, and consequently the time required to regain the former energy, is the same in both cases.

(2) The granulating area in the abdominal wall leaves a cicatrix which

is liable to yield and give rise to a ventral hernia. Though a hernia may arise after careful and close suture of an abdominal wound in its whole length, it is much more common in those cases in which part of the incision is allowed to close by granulations, as when drainage is employed or after the separation of the stump in extra-peritonæal hysterectomy.

Mr. E. S. Bishop (*Uterine Fibro-myomata*, 1901, p. 304), writing on the subject of hernia after hysterectomy for fibroids, says: "Since drainage through the abdominal wound has been entirely given up, and special care has been directed to the suture of the fascia, I have only seen one hernia, and that followed suppuration in the wound due to an imperfectly asepticised suture." As showing the frequency of hernia after the extra-peritonæal method, Mr. Cullingworth's experience may be quoted. Of ten cases so treated by him, two died, and five subsequently suffered from hernia in various degrees (quoted by Mr. Bishop, *loc. supra cit.*, p. 221).

(3) Another weak point in the operation is the risk of septic absorption attending the necessary sloughing of the stump.

(4) In comparing the mortality of the intra- and extra-peritonæal operations, it should be remembered that the former method has a wider range of utility than that in which the stump is fixed in the abdominal wall. There are many cases in which it would be found very difficult or impossible to draw the pedicle up into the ventral incision, and which can be readily dealt with by the intra-abdominal method.

Weill (*Ann. de Gynéc.*, 1899, vol. lii. p. 28) in 392 cases of extra-peritonæal treatment of the stump, collected by him from various sources, found the mortality to be 18·6 per cent. For purposes of comparison it is better, perhaps, to take the figures of one expert operator. Mr. Thornton states that the mortality of his cases was just under 8 per cent.; but these included all his early work. Practice with the serre-nœud has reduced his mortality by fully one-half, and he considers that "cases suitable for the serre-nœud, in which there is no unusually severe complication, may fairly be said to have a mortality of only 3 or 4 per cent." (*loc. supra cit.*, p. 621).

Noble has collected 345 cases of supra-vaginal amputation with intra-peritonæal treatment of the stump, and found the mortality to be 4·9 per cent. In the practice of individual men the death-rate is lower than this. Dr. Gow (*Med. Press and Circ.*, 1900, vol. i. p. 129) gives a list of forty-seven operations performed by him with only one death; and Dr. Howard Kelly states that "in one hundred consecutive abdominal hysterectomies, including all kinds of complications, I have lost two cases."

In comparing statistics collected from all sources, there is seen to be a great difference in the mortality; 18·6 per cent. for the extra-peritonæal as compared with 4·9 per cent. for the intra-peritoneal method. Such a comparison, however, is not of great value, as the former figures include many operations performed before the modern improvements in technique, whereas the latter percentage is based on comparatively recent work. There is probably not very much difference in the death-rate of the two methods in the hands of expert operators, and what difference there is may fairly be said, in the face of recent results, to be in favour of the intra-peritonæal operation. This being so, the treatment by the clamp loses its chief claim on our consideration, for in no other respect, either in rapidity, in its applicability to the varying conditions found, or in its freedom from subsequent complications, does it compare with the intra-abdominal method.

iii. Total Hysterectomy.

This may be called for in certain cases; when the uterus, for instance, is the seat of malignant growth, or when the position of a fibroid tumour does not permit of division through the cervix.

The operation is similar to that of partial hysterectomy, as far as the ligature of the uterine arteries.

Opening of Vagina.—These arteries having been secured, the tumour is held forward, and an opening is made through the bottom of Douglas's pouch into the posterior fornix, upon the end of a pair of forceps previously introduced through the vagina. A finger is then passed through the opening thus made, and carried forward across the cervix to act as a guide to the opening of the anterior fornix. The position of the already reflected bladder is then carefully noted, and the vagina again opened with scissors upon the finger in the anterior fornix. The anterior and posterior incisions are next freely lengthened, leaving the lateral attachments only of the vagina to the uterus. These should be secured with clamp forceps, and the uterus removed by incisions carried between the forceps and the cervix. The forceps are then removed, one at a time, and a careful examination made for any bleeding points, which should be secured and tied separately.

Closure of Peritonæum.—The next step is to unite the cut edges of peritonæum, and thus shut off the opening into the vagina from the peritonæal cavity. An iodoform gauze plug is introduced into the vagina from above, and drawn down until its upper end is level with the cut edges of the vagina. The operator then proceeds to approximate the edges of the peritonæum with a continuous suture. Having sewn together the two layers of the lower part of the broad ligament on one side, the anterior peritonæal flap is brought over the vaginal opening and secured to the posterior cut edge of peritonæum, the operation being completed by the closure of the broad ligament on the remaining side.

Dr. Howard Kelly's Method of performing Partial Hysterectomy (Hystero-myomectomy).

Dr. Kelly adopts a different procedure from that described above. Instead of tying and dividing the broad ligaments on both sides before severing the pedicle, he works across the pelvis from one side to the other, dividing first one broad ligament, then the pedicle, and finally dealing with the other broad ligament.

The stages of the operation as described by him (*loc. supra cit.*, p. 368) are shortly as follows:—

(*a*) **Preliminary Preparation of the Field of Operation, including the Skin and Vagina.**

(*b*) **Opening the Abdomen.**

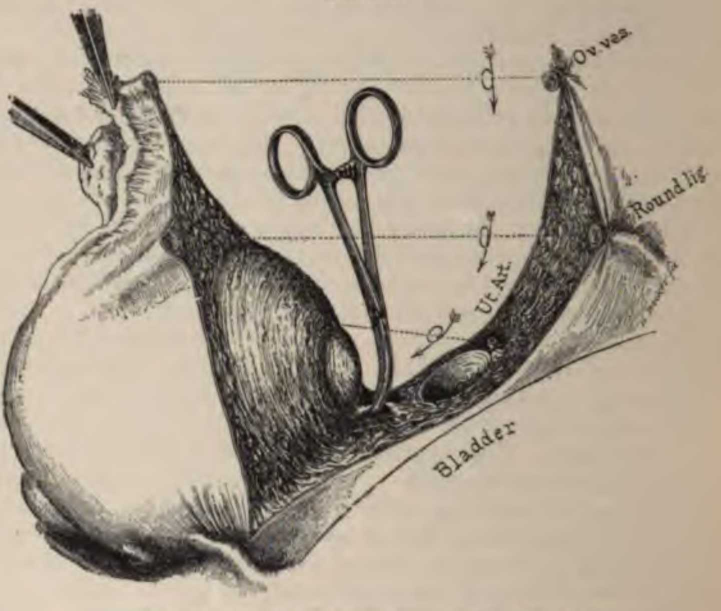
(*c*) **Delivering the Tumour, if possible.**

(*d*) **Ligation of the Ovarian Vessels and Round Ligament of one side, usually the left.**

In a woman under forty years of age he considers it better to leave both ovaries in the pelvis, with or without the uterine tubes. The broad ligament is divided between two sets of ligatures, or between forceps on the proximal and ligatures on the distal side, as previously described.

(*e*) **Detachment of the Vesico-uterine Fold of Peritonæum.**—The uterus being drawn back, "the anterior loose peritonæal fold along the curved line of the utero-vesical reflection is cut through from round ligament to round ligament. As the bladder is raised, the loose cellular tissue beneath it is exposed, and it may be still further freed by a rapid dissection with knife or scissors." The separation of the bladder is completed by pushing it well down with a sponge firmly compressed in sponge-forceps, until the cervix is bared almost or quite down to the vaginal junction.

Fig. 218.



The operation of hystero-myomectomy. (Kelly.)

By a continuous incision from left to right, ligating or clamping—at the points indicated by the arrows—first, the left ovarian vessels (Ov. ves.); next, the round ligament, and then the left uterine artery (Ut. Art). Finally, the cervix is cut across, and the uterus pulled away until the right uterine vessels are exposed.

(*f*) **Ligation of the Uterine Vessels of the same side.**—These vessels are now securely tied close to the cervix by a silk ligature on a curved needle passed close to the cervical tissue but not entering it.

(*g*) **Amputation of Uterus in Cervical Portion.**—The uterus is now drawn to the other side, and the uterine vessels are divided from 6–10 mm. above the ligature, an assistant being ready with artery-forceps to grasp any bleeding vessel left by chance out of the ligature. The uterus is now completely divided in its cervical portion, at a point just above the vaginal junction, and in such a way as to leave a cup-shaped pedicle. It is a good plan, when the cervix is nearly divided, to cut upward for one or two centimetres so as to leave behind a thin shell of cervical tissue, and expose the opposite uterine vessels at a higher level, when it is much easier to tie them without risk of including the ureter."

(*h*) **Clamping the Uterine Vessels of opposite side, the Round Ligament, and the Ovarian Vessels, followed by Removal of the Tumour.**—As the uterus is drawn up and rolled over on to its side, the uterine vessels come into view; these are seized in clamp forceps and divided. The uterus is rolled over still more till the round ligament is seen, which is clamped and divided, followed by similar treatment of the ovarian vessels. The whole mass is thus freed and taken away.

(*i*) **Application of Ligatures in place of Forceps.**—The parts now held in forceps (the ovarian vessels, the round ligament, and the uterine vessels) are successively tied with firm silk ligatures and the forceps removed.

(*j*) **Suturing the Cervical Stump.**—The stump is carefully examined for any bleeding points, which should be tied. It is now closed over the cervical canal by passing from three to five or more catgut sutures in an antero-posterior direction, and tying each one as it is passed. By suturing in this way the cup-shaped pedicle is changed into a transverse linear wound. Should there be a discharge of pus from the uterus or a muco-purulent plug in the canal, this latter should be wiped out with gauze as soon as cut across, and afterwards dissected out with a sharp knife and forceps.

(*k*) **Covering the Wound-Area with Peritonæum.**—The large flap of peritonæum which lies in front of the pedicle is drawn over the stump and sutured to the posterior peritonæum by a continuous suture.

CANCER OF THE UTERUS.

Cancer of the Body.—In cases suitable for radical treatment the uterus may be removed, either through the vagina or by an abdominal incision, the choice of route being determined by the size of the body. The indications for operation are practically the same as those given in the next section on cancer of the cervix. Should the abdominal route be chosen, the operation is in all essentials similar to that described for fibroids, the whole of the uterus being of necessity removed. Hysterectomy by the vaginal route is similar to that described for carcinoma of the cervix.

Vaginal Hysterectomy for Carcinoma of the Cervix.

To determine whether Case is suitable for Removal of the Uterus.—It is not easy in a case of cancer of the cervix to say whether the whole disease can be eradicated, as growth may have extended beyond the limits of the uterus, and yet be inappreciable on the most careful examination.

To determine whether a case is operable, the different routes by which the growth may advance must be carefully borne in mind, and a systematic examination made of each. They are as follows:—

(1) The growth may involve the fornices or extend down on to the vaginal walls.

(2) It may extend forwards and involve the bladder.

(3) It may extend outwards in the broad [illegible]

(4) Or extend backwards in the utero-sacral folds and involve the rectum.

In examining a case the first thing to be noted is the mobility of the uterus. This may be tested most efficiently by fixing a pair of tenaculum forceps into the cervix, and observing whether the organ can be drawn down readily towards the vulva. If there is complete or considerable fixation and extension of growth in any of the above-mentioned directions the case is inoperable, and should be left alone. The cervix should be examined, not only digitally, but through a speculum, and the extent to which the fornices or the walls of the vagina are involved carefully noted. To determine whether extension laterally into the broad ligaments or backwards in the utero-sacral folds has taken place, the vaginal examination must be supplemented by a rectal one, and a search made for any masses or thickening in these situations.

If the uterus is freely movable, and can be pulled down to the vulva, and there is nothing to be felt in the broad ligaments or utero-sacral folds, the case is a favourable one for operation, and there are good grounds for hope of permanent relief.

But between the eminently favourable cases and those that are to be regarded as inoperable, certain cases are to be met with, not infrequently, in which there exists an element of doubt as to whether the growth can be entirely removed. On this point, Dr. Howard Kelly's remarks are worth quoting: "In concluding whether or not to operate, the patient should in all cases have the benefit of any reasonable doubt, and the operator must not be too exacting in restricting his indications. I have operated several times where the disease was found so advanced that there could be no reasonable question but that some portion of it was left behind, and this was confirmed by a microscopic examination of the specimen, which showed cancer cells right up to the cut edge of the broad ligament, and yet one of these patients enjoyed perfect health for five years, when the disease reappeared in the glands of the neck; another had a local return after three years of good health, and two others are living, apparently in perfect health, three and four years after the operation" (*loc. supra cit.*, p. 319).

Is an operation justifiable in cases in which no hope can be reasonably entertained of a permanent cure? In considering this question, the influence that repeated losses of blood and continuous septic absorption from the breaking-down cancerous mass have on the health of the patient should be borne in mind. If under the circumstances there is reason to think that the uterus can be removed without unusual risk, the surgeon is justified in operating after laying the facts of the case fairly before the patient. For recurrence of the disease, so long as it does not take place in the vaginal roof, will be attended with less pain, an absence of hæmorrhage and a relief from the distress dependent on a fœtid discharge.

No radical operation should be undertaken if extension of growth has led to involvement of bladder, ureters, or rectum. Wide extension into the broad ligaments will give rise to grave danger of injury to the ureters. Moreover, difficulty will be experienced in the application of ligatures or forceps, which are, further, likely to slip off from the friable cancerous growth.

Palliation may be afforded in some inoperable cases by a free scraping away of the growth in the cervix, followed by the application of Paquelin's cautery. Great hopes of relief should not be held out to the patient as likely to follow this procedure, nor should the operation be urged on her. The growth, with its attendant hæmorrhage and discharge, may recur very soon, and on one or two occasions extension of the growth has appeared to me to be accelerated

Operation.—There are many modifications in the various stages of this operation adopted by different surgeons, the chief of which is the treatment of the broad ligaments, some preferring to tie these with silk or catgut, others to clamp them.

Preliminary Treatment.—For some days beforehand the vagina should be freely douched with some antiseptic lotion, such as 1-500 formalin.

For the operation the patient is placed in the lithotomy position, and the legs secured by means of a Clover's crutch. The perinæum is retracted with a Sim's or Simon's speculum. Lateral retractors may be found useful at certain stages of the operation. The cervix is drawn down to the vulva by vulsella, one pair of forceps being applied, as a rule, to the anterior lip, one to the posterior. The point of attachment will, however, depend to some extent on the condition of the cervix. In the case of large cauliflower excrescences it will often be found necessary, as a preliminary to freeing the uterus, to remove the growth freely with scissors and sharp spoon. Some surgeons prefer, in all cases in which there is exposed cancerous growth on the cervix, to remove it before commencing the operation. This procedure is based on sound principles. In the removal of cancer elsewhere in the body, every precaution that is possible is taken against the reinfection of the wound surfaces by cancerous material. That raw surfaces may be inoculated in this way is abundantly proved by clinical and experimental evidence. Mr. Herman, amongst others, recommends that all exposed growth should be thoroughly scraped away with a sharp spoon until firm tissue is reached. A Paquelin's cautery is then applied to the whole surface. By this means the chance of reinfection of the operation wounds is greatly minimised (*Diseases of Women*, p. 380). In Dr. Baldy's *Gynæcology* (1894, p. 389) it is further recommended that the funnel-shaped excavation made by the spoon and cautery be stuffed with iodoform gauze, and the lips of the cavity sewn together by means of a continuous suture.

Separation of Bladder.—It is not a matter of great importance whether the surgeon begins by separating the bladder or by opening Douglas's pouch. If he choose the former, the line of reflection of the bladder from the cervix is ascertained by passing a bladder sound, or, as Mr. Herman recommends, by grasping the mucous membrane and noting the line at which you begin to be able easily to pull it from the uterus.

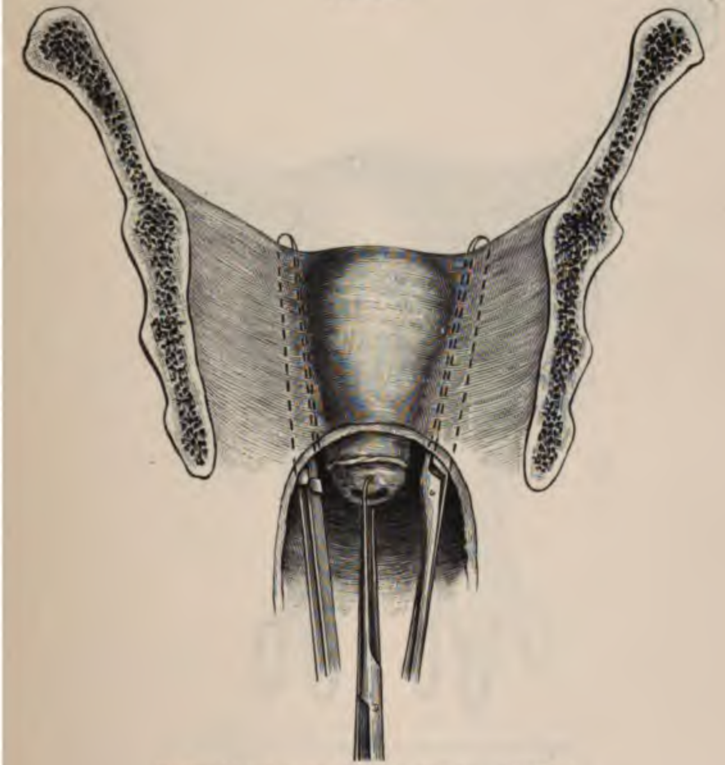
With a blunt-pointed pair of scissors the mucous membrane of the anterior fornix is incised in the median line just below the line of reflection of the bladder, and the incision prolonged laterally so as to surround the cervix in front. The operator cuts down until the wall of the uterus is reached, and then proceeds to strip off the bladder from the front of the cervix with the fingers, keeping close against the uterus the whole time. Any bands that resist separation by the fingers may be divided with scissors. It is most important that this separation be extended well to the sides of the uterus, for by doing so not only is the bladder saved from chance of injury in the subsequent manipulations, but the ureters are pushed well out of the way. The anterior peritonæum having been reached, is opened by pushing a sound or blunt pair of forceps through it, or divided carefully with a pair of scissors, the opening being subsequently enlarged with the fingers. In some cases, on account of peri-uterine inflammation, difficulty may be experienced in separating the bladder from the uterus, and considerable risk incurred of opening the former. Should this happen the injury should be at once repaired. If growth is found to have extended forwards and involved the walls of the bladder, the operation had better be discontinued.

Opening Douglas's Pouch.—An incision is next made through the mucous membrane of the posterior fornix, so as to open Douglas's pouch. It is prolonged laterally so as to meet the extremities of the anterior incision, care being taken not to cut so deeply as to wound the uterine arteries. There is no fear of this, if the incision at the sides is made through the mucous membrane only. In making the posterior division the cervix should be held well forward by the vulsella, and the points of the scissors directed towards the uterus to avoid risk of injury to the rectum. With care there is no great risk of this accident, unless the posterior fornix has been much encroached on by the growth. The opening in the peritonæum is then prolonged laterally with scissors, or, as some prefer, enlarged by tearing with the two forefingers. A difficulty met with at this stage in entering Douglas's pouch may be due to the incision being carried through the mucous membrane only, and the peritonæum separated and pushed before the finger. It is unnecessary to pass a sponge through the posterior opening into Douglas's pouch, as recommended by some operators, unless actual protrusion of intestines takes place. Any bleeding points in the cut edges of the vagina should be secured by pressure-forceps. A fear of hæmorrhage occurring some hours after the operation has led to various modifications of this part of the operation. In Dr. Baldy's work (*loc. supra cit.*, p. 389), for instance, it is recommended that the peritonæum be sewn to the cut edge of the vagina by a continuous catgut suture; and Dr. Sinclair (Allbutt and Playfair, *Syst. of Gyn.*, p. 688) ligatures the vaginal wall before dividing it. By these proceedings, the operation is unnecessarily complicated, and the possibility of hæmorrhage from this source is neglected by the majority of surgeons.

The Management of the Broad Ligaments.—This stage of the operation is the one that has met with the greatest variety of treatment at the hands of different surgeons; and it is not difficult to see the reason of this. The inconveniences connected with long silk ligatures, the dangers attendant on the use of clamps, the advantages or disadvantages of closing the vaginal vault have influenced in various degrees different operators in the choice of one variety or another. I will first describe the method of securing the broad ligaments by sutures. For this purpose Dr. Galabin uses a needle curved in a plane nearly at right angles to the handle, or two may be used, curved respectively to the right and left for the corresponding broad ligaments (Baldy). Coming at the lower part of these structures, and working first on one then on the other, successive portions are tied with silk and ed. As the division proceeds, the uterus is pulled lower and lower, of all the cervix and then the body being freed from its lateral hments. Dr. Galabin (*Dis. of Women*, 1893, p. 323) points out "as soon as the centre of the uterus is divided from the utero-l ligaments, the fundus can generally be drawn down much further he upper part of the broad ligament brought within reach."

e tying of the upper part of the broad ligaments is facilitated by ig the fundus with vulsella, retroflexing it, and dragging it out igh the posterior opening made into Douglas's pouch. The body however, be too enlarged to allow of this. By this manipulation

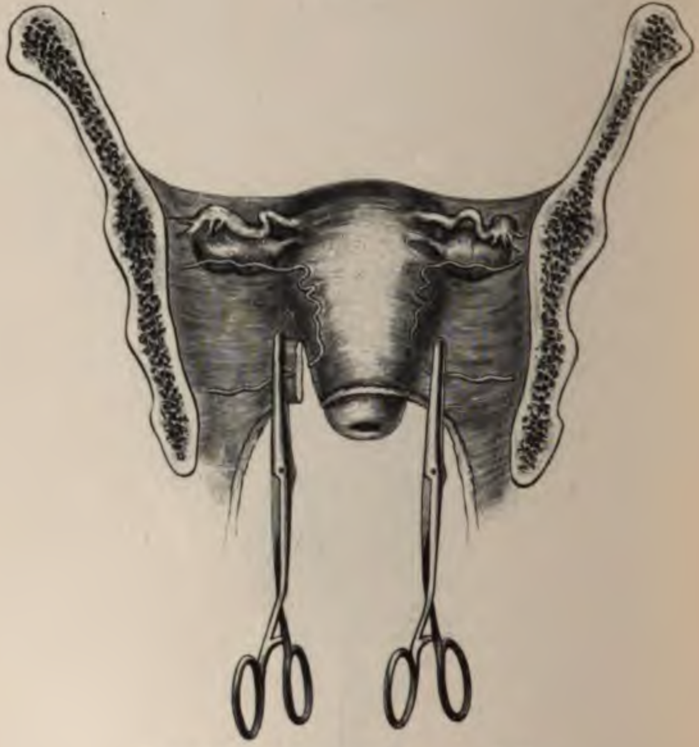
FIG. 219.



Vaginal hysterectomy with clamps. (Baldy.)
Single-clamp operation.

ipper parts of the broad ligaments are brought within easy reach, ire readily transfixed by a double ligature and tied in two halves. lk is made use of for the ligatures, the ends should be left long cilitate their removal. The use of this material, however, pre- certain disadvantages. If the ends are left long, and the ps cannot be drawn down and fixed in the vaginal roof, so as to er them extra-peritonæal, the silk strands serve as a track along h infection may spread upwards from the vagina. If cut short and left in the pelvis, they are very likely to serve as septic foreign bodies, round which accumulations of pus may take place. In their stead catgut has been recommended as being absorbable, and, further, as being less likely to slip than silk. These are cut short, whether left within or outside the peritonæum. The objections to ligatures, whether silk or catgut, are these: they are more difficult to apply than clamps and the operation takes longer. Whether ligatures or suitable clamps, properly applied, are the more liable to slip is a point difficult to decide; secondary hæmorrhage may result from the use of either. The greatest objection to the ligature is the fact that, whatever precautions are taken, it may serve as a septic foreign body. Not even the catgut ligature is free from this reproach. A point in favour of tying the stumps is that these latter can be drawn down into the vaginal vault, and thus rendered entirely, or almost entirely, extra-peritonæal. The method of doing so will be referred to later.

FIG. 220.



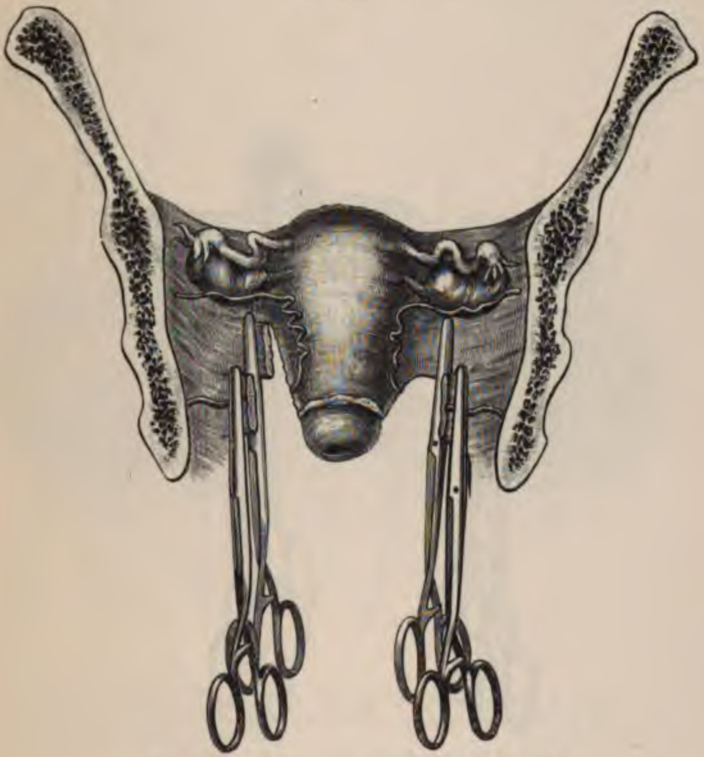
Vaginal hysterectomy with clamps. (Baldy.)
Multiple-clamp operation: first step.

Although an equal number of objections may be urged against the use of clamps, I prefer this latter method of operating, largely on account of the greater ease and rapidity of procedure.

Against their use it has been urged that they prevent closure of the vaginal vault, and that the large open channel thus left invites contamination of the pelvic peritonæum. But this open space provides such free drainage that peritonitis is a very rare accident, and pelvic abscess is seldom seen. It is thought that there is a greater risk of including the ureter in the grasp of the forceps, or a danger of catching the intestine in the points of the forceps. This latter may be avoided with care, and the former accident by freely separating and pushing aside the soft parts at the side of the uterus.

Numerous forms of forceps are employed for clamping the broad ligaments. The ones I prefer are Doyen's, with strong spring blades, which come into close apposition when closed. Either one long pair (Fig. 219) may be applied on each side, embracing the whole ligament, or two or more shorter pairs may be employed (Figs. 220, 221, 222). The latter method is, I think, preferable to the former. It is easier to apply the forceps to a half or less of the broad ligament than to the whole of it; there is less risk of slipping, and as the uterus is separated from its attachments and brought lower down, there is less risk of catching a loop of intestine in the ends of the blades. There is less objection to the single-clamp operation if the broad ligaments are short and the finger can readily be passed beyond them; but when they are long and

Fig. 221.

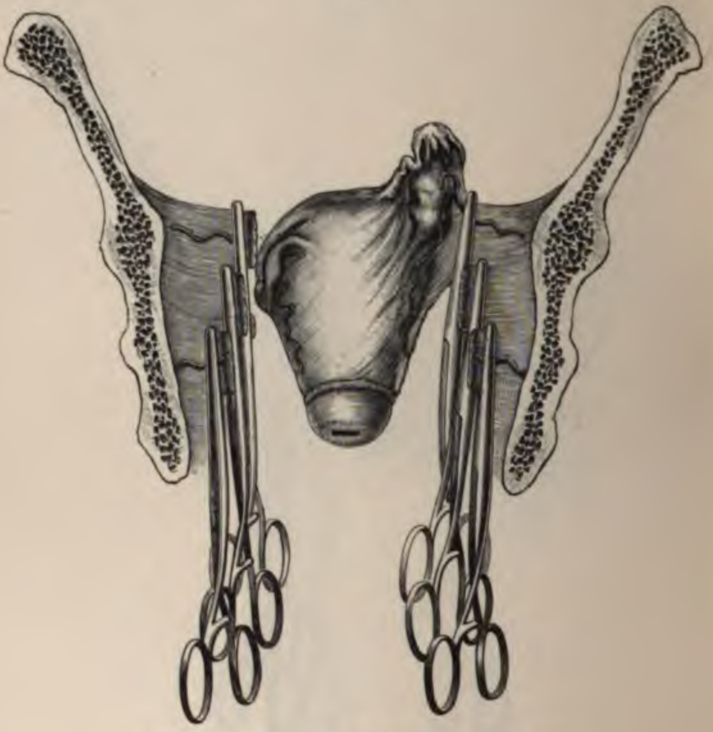


Vaginal hysterectomy with clamps. (Baldy.)
Multiple-clamp operation: second step.

the upper border cannot be felt, the forceps should be applied no farther than the finger can reach, the upper part of the ligament being secured by a second pair.

In applying the forceps the front and back of the ligament are carefully examined by the finger, to make certain that the bladder has been well separated at the sides, and that there is no intestine in close contiguity. With one finger in front and another behind the broad ligament, the two blades of the forceps are guided into position, and the parts being again carefully examined, tightened up. If the entire ligament is to be secured in the grasp of one pair, they must be passed beyond its upper border, and care taken that no intestine is included.

Fig. 222.



Vaginal hysterectomy with clamps. (Baldy.)
Multiple-clamp operation: third and final step.

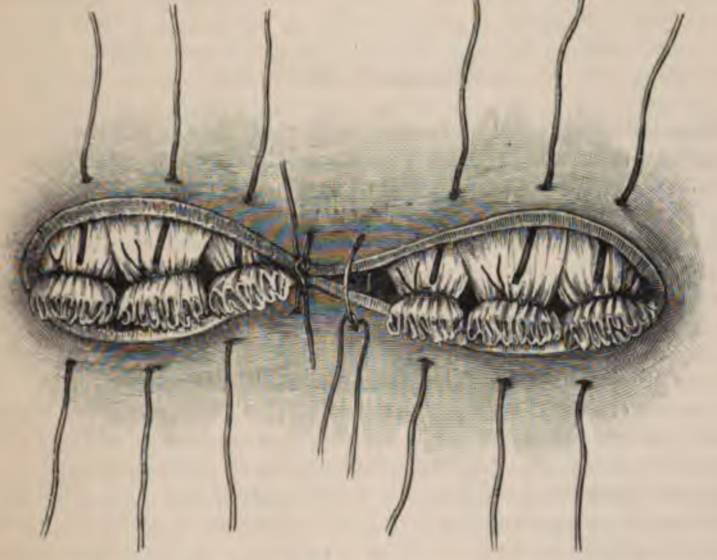
A similar proceeding is carried out on the opposite side. The forceps having been applied, the ligament is divided between the forceps and the uterus. If the clamps have embraced a part only of the broad ligament on each side, a second pair are now applied, and the uterus thus separated in successive portions.

Closure of Vault of Vagina.—In this, as in the other stages of the operation, practice varies widely, some surgeons employing no sutures at all, others partially or entirely shutting off the peritonæal cavity.

Where silk ligatures are employed the stumps should, if possible, be rendered extra-peritonæal. This is effected as follows:—

By means of the ligatures, which have been left long, the pedicle on one side is pulled down below the level of the cut edge of the vagina and fixed in position by two or three catgut sutures. The same proceeding is carried out on the opposite side (Fig. 223). By this means the peritonæal cavity is almost entirely shut off, a small opening only being left in the centre of the vault for drainage. Even this is dispensed with by some surgeons, the vaginal wound being completely closed by the insertion of one or two stitches in the median line (Fig. 223). By the employment of catgut, Olshausen has been enabled to completely close the peritonæal cavity, leaving the stumps in the pelvis. The gut ligatures are cut short and the pedicles allowed to retract within the peritonæal sac. The wound is then closed by sutures passed from before backwards through the edges of the anterior vaginal wall, the anterior layer of peritonæum, the posterior peritonæum, and the posterior wall of vagina. His success has not been obtained by everyone who has followed his methods. Dr. Sinclair (*loc. supra cit.*, p. 690) says: "After Olshausen's success in completing the operation by cutting short the broad ligament ligatures, and completely closing the wound in the pelvis, I tried for a time to do without drainage, but found the result unsatisfactory. Several times, owing to unfavourable symptoms which followed, it was necessary to undo some stitches in order to permit of the escape of retained fluid." Considering the diffi-

FIG. 223.



Vaginal hysterectomy with the ligature-stumps drawn into the vagina, with sutures in place ready to close the opening in the vaginal vault. (Baldy.)

culties of cleansing the vagina, there must always be some risk of infection during the operation, and it appears on the whole safer to provide for drainage of the pelvic pouch, especially when ligatures are left within it. When forceps are employed the stumps cannot be rendered extra-peritonæal. If at the time of operation there appeared to be a tendency to prolapse of the intestines, a stitch or two might be inserted in the centre of the vaginal roof; but otherwise they are not necessary.

After-treatment.—After the removal of the uterus, the vagina is loosely packed with a strip of iodoform gauze, and if forceps are used the gauze should be wrapped round their handles where they lie in contact with the vulva. The forceps are removed at the end of thirty-six hours, and the plug of gauze renewed. When sutures are employed the gauze plug may be left in three or four days. It is better not to employ a douche for the first five or six days, though, if carefully given by the surgeon himself, there is not much danger in its use after the second day.

CÆSARIAN SECTION.

Indications.—(1) An extreme degree of pelvic contraction, when the smallest diameter through which the child has to pass is less than two inches.

(2) Solid tumours of the pelvis or uterus, which cannot be pushed out of the way; cancer of the cervix and cicatricial contraction of the passages.

(3) In any case in which there is no hope of obtaining a living child, even by the induction of premature labour, it is reasonable to offer the mother the option of undergoing a somewhat greater risk to save the life of the child (Dr. Galabin, *Manual of Midwifery*). Under these circumstances, Cæsarian section further offers the great advantage that the patient can be sterilised by resection or removal of the Fallopian tubes, if the conditions causing obstruction are permanent ones.

Time of Operating.—There are three possibilities: (1) To wait until labour comes on spontaneously. (2) To operate at a certain fixed time before the commencement of labour pains. (3) To induce labour by the passage of a bougie and operate at a pre-arranged time.

The great objection to waiting for the onset of natural labour is that the operation may have to be performed at night, often without the necessary assistance and with the patient imperfectly prepared. For these reasons many surgeons prefer to operate at a definite time, which is arranged for a few days before full term. This is undoubtedly the most satisfactory plan. The operation can be undertaken in daylight, the needful assistance is forthcoming, and the patient can undergo the proper preliminary treatment—as necessary in Cæsarian section as for any other abdominal operation. The chief objection made to operating before the onset of labour is that the uterus may not contract well, with the risk of hæmorrhage that imperfect contraction entails. Practical experience has, however, shown that the fear of uterine inertia and bleeding is unfounded. If the surgeon prefers to operate after labour pains have commenced, he may still do so at a pre-arranged time by passing a bougie over-night. It is possible that the pains may not come on by the time arranged. Under these circumstances he must either defer his operation until they appear, which may be at a most unsuitable time, or operate without pains. The latter alternative is the better one. Dr. Kelly says that he has met with no such accident as the failure of the uterus to contract and hæmorrhage as the result of operating without waiting for the pains to come on (*loc. supra cit.*, vol. ii. p. 417).

Operation.—The patient is prepared as for ovariotomy, attention being paid to the diet, the regulation of the bowels and the points previously mentioned. The abdomen is thoroughly cleansed, and the vagina douched with 1-1000 sublimate solution or other antiseptic. There should be two assistants in addition to the anæsthetist, one to stand opposite the surgeon and assist in the various manipulations, the other to hand instruments, whilst someone, in addition, should be present who is competent to attend to the child when delivered.

Abdominal Incision.—The incision through the abdominal wall should be six inches long, of which about a third will be above the umbilicus, whilst the lower end should not be nearer than two or three inches to the pubes. The incision is made deliberately in the median line, as already described in the operation for ovariotomy, all bleeding points being carefully arrested. The peritonæum, being reached, is picked up and opened, and then divided on the fingers for the full length of the skin incision. In dividing this structure downwards towards the pubes, the fingers, used as directors, will serve to detect the bladder if this is much drawn up—a complication most likely to be found when labour has been protracted. It has been the custom to employ the rubber tube introduced by Müller to control hæmorrhage from the uterus during the operation. This tube, which is about a yard long, is passed over the fundus of the uterus and adjusted round its lower segment. By its employment the loss of blood during the operation is very slight, and the surgeon may be as deliberate as he pleases. If applied for too long it has the grave disadvantage of producing uterine inertia and hæmorrhage from interference with the blood-supply to the muscle. When competent assistance is at hand, the operator will, therefore, do well to discard it, and trust, if hæmorrhage is severe, to compression by the assistant's hands of the broad ligaments against the lower uterine segment. If good assistance is not obtainable, it may be thrown round the uterus as a precautionary measure, to be employed if necessity arises. The next step is the opening of the uterus, and this and the following stages in the operation should be performed as rapidly as possible.

Incision of Uterus.—The assistant should, as recommended by Mr. Herman, place a hand on each side of the abdominal wall, and press it downwards and backwards, so as to make the wound gape and prevent fluid entering the peritonæal cavity. The surgeon cuts through the uterine wall at one spot till the membranes are reached, and then rapidly enlarges the incision up and down till it is nearly the length of the abdominal incision, that is, nearly six inches long. If the placenta is beneath the incision it is usually recommended that it be cut through. Dr. Kelly thinks this a mistake, and recommends that the nearest border be sought for and the membranes opened there. Hæmorrhage is usually moderate, unless the placenta is attached to the anterior wall. If from this cause the bleeding is alarming, it should be controlled by an assistant grasping the lower part of the uterus and compressing the broad ligaments, or by tightening the elastic ligature if this has been previously applied.

Extraction of Child.—The uterus having been opened, the surgeon introduces a hand and seizes a knee or foot and delivers the child. It has been recommended, on account of occasional trouble in the extraction of the after-coming head, that this should be delivered first. It is not, however, easy to grasp, and will probably require both hands, which take up more room than is convenient in the uterine wound. Difficulty in extraction of the head is generally due to too small an incision in the uterine wall. The child having been delivered, the funis is tied and divided, or time may be saved by clamping it temporarily and tying the fœtal end after division. After the removal of the child, the uterus, being sufficiently diminished in size, is brought out through the abdominal wound, and a large flat sponge or gauze swab placed behind it. If the elastic ligature is employed, it may now be tightened up, but, on account of the objections given above, its use is not recommended under ordinary circumstances, compression by the assistant's hands being employed instead. The placenta and membranes are then carefully peeled off the uterine wall and removed, and the interior of the uterus mopped over with 1-1000 sublimate solution. If the uterus does not contract readily, it should be stimulated to do so by compression.

Uterine Sutures.—Silk is the best material to use for this purpose, and both deep and superficial sutures should be employed. Of the deep, about ten should be inserted about half an inch or rather more apart. They are introduced half an inch from the edge of the wound on a half-curved or fully-curved needle, and are brought out on the cut surface close to, but not including, the decidual surface of the uterus. For the superficial ones Lembert's suture is made use of, fine silk being introduced one-third of an inch from the cut edge of the peritonæum and brought out again close to the edge, the reverse procedure being adopted on the opposite side. When the sutures are tied, the two edges of peritonæum are turned in, and are in apposition along the line of incision.

Sterilisation of Patient.—If the condition requiring Cæsarian section is one which cannot be remedied, and the patient runs the risk of a subsequent pregnancy, she should be sterilised. This is done by removing as much as possible of the Fallopian tube.

The tube being picked up, a double ligature, threaded on a pedicle needle, is passed through the broad ligament a sufficient distance below it. The loop having been divided, the two strands are interlocked, and one is tied round the tube close to its uterine end, whilst the other is tied round the free edge of the broad ligament beyond the fimbriated extremity. The ovary should not be included in the ligature, which should be carried between it and the Fallopian tube. The tube is then cut away between the two ligatures.

The subsequent stages of the operation and the after-treatment are similar to those described in the operation of ovariotomy.

PORRO'S OPERATION.

Porro's modification of Cæsarian section consists in supra-vaginal amputation of the uterus and fixation of the stump in the lower angle of the wound. But under this heading are now included partial hysterectomy with intra-peritonæal treatment of the stump and total hysterectomy.

The simplest method, and the one best adapted for those inexperienced in abdominal surgery, is the operation devised by Porro. It has received various modifications, and that described by Mr. Herman (*Difficult Labour*) after the method of the late Mr. Lawson Tait, may be regarded as the best on account of the simplicity of its details and the few instruments required.

The abdomen having been opened, as described in Cæsarian section, a rubber tube, two feet long, is slipped over the fundus and adjusted round the lower part of the uterus. The ends of the tube are tied in a single hitch, and prevented from slipping by being grasped in a pair of forceps. The uterus is then opened at one point, and the incision enlarged by tearing with the fingers. The child is then extracted. The uterus is now brought out of the abdomen, the ligature tightened if necessary and tied a second time. Two knitting needles are passed from side to side through the flattened rubber tube and the cervix, and the uterus cut off about three-quarters of an inch above the needles. The abdominal wound is sewn up with interrupted silkworm gut sutures about two-thirds of an inch apart, the lowest stitch being passed through the stump below the elastic ligature, as well as through the abdominal wall. The stump is dressed with iodoform and tannic acid powder, and covered with a layer of dry dressing.

This operation carries with it the risks and disadvantages already mentioned in the section on hysterectomy, and the expert operator will prefer, after removing the uterus, to treat the stump by the intra-peritonæal method. The details of this operation are similar to those mentioned above in the removal of the uterus for fibroids.

Indications for the operation are as follows :—

1. Failure of the uterus to contract after removal of the child.
2. Injuries to the uterus sustained in efforts to deliver through the pelvis, such as rupture.
3. The fact that the operator is inexperienced. In this case he should adopt the method of amputation with fixation of the stump in the abdominal wound, as described above.

Removal of the uterus may be indicated in the radical treatment of the condition giving rise to the obstruction. This gives such further indications as follows :—

4. When the uterus contains myomatous tumours which block the pelvis, or which cannot safely be removed by myomectomy (Kelly).
5. When there are bilateral ovarian tumours, and no sound part of an ovary can be found and left (Kelly).
6. When the patient is suffering from osteo-malacia (Herman). The removal of the ovaries has been found to have a curative effect on this disease. In the two latter conditions the uterus is removed, as it is no longer of use to the patient after the ovaries have been taken away.

7. When there is cancer of the cervix (Kelly). If this condition is found to exist, and hysterectomy is decided on, the whole uterus must be removed.

ECTOPIC GESTATION.

From the point of view of treatment cases of extra-uterine gestation are best considered under three headings: (1) Before rupture has taken place; (2) at the time of rupture; (3) after rupture.

1. Cases in which the Tube is Unruptured.

As rupture of the tube almost invariably occurs before the tenth week, this class may be held to include cases of extra-uterine gestation up to two and a-half months. It is rarely, however, that the condition is diagnosed, and after diagnosis it is not unlikely that the condition may be found to be one of hydro- or pyo-salpinx. If there is any suspicion that a tubal pregnancy exists, the patient should submit to operation at once. Delay means the risk of rupture and severe or fatal hæmorrhage. The operation is practically identical with that described for removal of the appendages. Adhesions are recent, and do not give rise to much trouble. Care must be taken not to rupture the sac in the separation of adhesions or in drawing it up into the wound for the purpose of ligaturing the broad ligament. Should severe hæmorrhage from this cause occur, it should be controlled by quickly applying the ligatures to the pedicle, or by controlling the blood-supply at the uterine cornu and the brim of the pelvis.

2. Tubal Abortion or Rupture.

The condition most often calling for operative measures is the result of rupture of the tube, or abortion. Rupture may take place either into the peritonæal cavity or between the layers of the broad ligament. It more often happens, however, that hæmorrhage takes place into the fœtal membranes, with the production of a mole, and this is expelled in whole or in part through the dilated ostium of the Fallopian tube into the peritonæal sac. This event, which is known as tubal abortion, is accompanied by hæmorrhage. Though likely to be continuous or frequently repeated, the bleeding is much more moderate in amount as a rule than that following a rupture, which is often profuse and attended with grave danger to life.

Should an operation be performed in all cases in which this accident is diagnosed? We know that many cases get well if left alone, though what proportion they bear to those requiring operation we cannot at present say. A patient occasionally dies of hæmorrhage before assistance can be obtained, whilst in many instances, on the other hand, the initial symptoms are so slight that the patient pays but little attention to them, and it is only on account of a persistence or a recurrence of pain that a surgeon is called in, perhaps weeks after the onset. When the symptoms are so grave that life is threatened, there can be no doubt as to the advisability of immediate operation. But if the patient is recovering when first seen, and the collapse and signs of hæmorrhage are not severe, the indications are less clear. There is no doubt that in most cases no ill results will follow from delay for a time. But though the initial bleeding is slight, it may recur later with greater severity, and the danger of temporising in any recent case should consequently be fully recognised. If a diagnosis of rupture into a broad ligament can be made, it is perfectly justifiable to wait awhile, as the hæmorrhage will, in all probability, soon cease, and the hæmatocele can, if necessity arises, be dealt with later by drainage.

The Operation.—An incision, four to five inches long, is made in the median line and carried well down to the pubes. If the case is a severe one, blood may at once escape from the abdomen when the peritonæum is opened. This is mopped and scooped out as rapidly as possible, and if it appears that hæmorrhage is continuing, no attempt should be made to cleanse the peritonæal sac, but the bleeding controlled at once. This is done by identifying the fundus and tracing the affected tube outwards from this. The sac is drawn up towards the wound, and a pair of Spencer Wells's forceps are applied to the uterine end of the tube, so as to include in its grasp the terminal branches of the uterine artery, and a second pair to the broad ligament at the brim of the pelvis to secure the ovarian artery. The abdomen can then be cleansed by means of sponges or by washing out with warm water, and the parts inspected. The tube is then brought up into the wound and ligatures applied, as described in the section on the removal of the appendages.

3. **After Rupture of Sac.**

In the majority of cases, fortunately, the fœtus is destroyed in the early months of pregnancy, either in the tube or after its escape into the abdominal cavity or between the layers of the broad ligament. Treatment then resolves itself into dealing with a collection of blood in the pelvis, either shut off by adhesions and matted viscera from the general peritonæal cavity, or lying between the layers of the broad ligament. If there is no evidence that bleeding is recurring, the patient should be treated by rest, in the hopes that the hæmatocele will subside.

If on account of recurrent attacks of pain and marked anæmia there is reason to suspect repeated hæmorrhages, abdominal section should be performed and the tube removed. This will differ from the operation undertaken at the time of rupture in that the tube and blood-clot will be found enclosed by adhesions and matted bowel and omentum. These latter must be carefully separated until the sac and surrounding blood-clot are brought into view. The tube is then dealt with as previously described.

If there are no signs of fresh bleeding, and the hæmatocele, which is bulging down Douglas's pouch, shows little tendency to diminish in size as the result of rest, it should be treated by drainage through the vagina. When rupture has taken place into the broad ligament, Dr. Kelly (*loc. supra cit.*, vol. ii. p. 456) considers that the proper treatment is to evacuate and drain the sac extra-peritonæally, either by the vagina or above Poupart's ligament. It should be opened in the latter situation when "the sac elevates the peritonæum of the anterior abdominal wall, so as to be easily accessible from the front."

If the fœtus survives, the dangers of operation increase as pregnancy advances, and no time should be lost in arranging for as early an operation as possible. The great difficulty that the surgeon has to contend with is the treatment of the placenta. This organ and its site are certain to bleed very freely at the operation if any detachment occurs; and if the placenta is left behind in the sac there is th greatest possible risk of septic absorption.

If the incision in the abdominal wall can be made so as to avoid th organ, whose position may be sometimes recognised by palpation (nev by auscultation, and this must be remembered, since many autho wrongly state that the situation of the placenta can be ascertained b means of the uterine bruit) so much the better. The best place t choose is where the fœtal outlines can be most plainly felt. The sac should be opened extra-peritonæally if possible. The child is extracted and a clamp put on the cord, which is divided on the maternal side of the clip. If there is any possibility of completely removing the sac this should be carefully considered, as by such a procedure much of the difficulty afterwards is removed. It is, however, scarcely ever possible to do so, and the sac must be stitched to the edges of the abdominal wound. The blood should be allowed to escape as completely as possible from the placenta through the divided vessels of the cord, and if the placenta cannot be safely stripped off the sac-wall it must be left behind, and the cord should be cut short off. The sac is then plugged with strips of gauze during the time that the placenta is being expelled. The opening must be carefully watched and not allowed to close, and no accumulation of fluid is to be permitted.

If the child has been dead for some weeks at the time of operation, and the circulation through the placenta has dwindled considerably, it may not be difficult to remove the placenta without much bloodshed, and this should always be attempted; if it cannot be done, the case must be treated in the way just described.

CHAPTER XVIII.

SACRO-ILIAC DISEASE.

ARTHRECTOMY.

It has been shown that the prognosis in this disease, usually looked upon as so grave, is much better if the same radical methods of treatment, which have proved so satisfactory in other joints, are applied to the sacro-iliac synchondrosis.

Mr. Collier first drew attention to the above fact with a case successfully treated by trephining (*Lancet*, 1889, vol. ii. p. 787), and Mr. Makins and Mr. Golding Bird followed, each surgeon publishing three successful cases (*Clin. Soc. Trans.*, vol. xxvi. p. 127, and vol. xxviii. p. 186). The following points are taken from these papers:

Operation.—The joint is exposed by a crucial incision (Makins), or by a flap (Collier, Golding Bird). In the words of the last-named surgeon, "a semicircular flap of skin and subcutaneous tissue over the iliac area of the joint, and having its convexity corresponding to the posterior edge of the ilium is dissected upwards and forwards, and the underlying glutæi are detached. The bone being thus freely exposed, a large trephine is applied at the root of the posterior inferior iliac spine, and in a line drawn from the top of that spine to the junction of the anterior with the middle third of the iliac crest. . . . . The ilium at the seat of operation is very thick, but the disc of bone removed should reach quite down to the joint." The trephine-opening is then sufficiently enlarged, the articular surfaces cut away with a gouge or forceps sufficiently to enable the surgeon to explore the pelvic surface of the joint, and to liberate any pus lying on this aspect. The sharp spoon, or Barker's flushing gouge (p. 601) is then thoroughly used, all fragments of bone, granulation tissue, or loosened cartilage removed, and any sinuses present laid open. Sterilised iodoform having been next applied, the soft parts are lightly drawn together with a few sutures. A long outside, or a Thomas's hip-splint, should be used at first, but subsequently, all that is needed is a well-fitting pelvic belt, as advised by Mr. Hilton.

PART V.

OPERATIONS ON THE LOWER EXTREMITY.

CHAPTER I.

OPERATIONS ON THE HIP-JOINT.

AMPUTATION AT THE HIP-JOINT. EXCISION OF THE HIP-JOINT.

AMPUTATION AT THE HIP-JOINT (Figs. 224-233).

THIS formidable operation has been much simplified of late years by the most important improvement of Mr. Furneaux Jordan,* whose method should replace all others in every possible case. It will be described first here, and a few of the other methods, sufficient for all practical purposes, will be given afterwards.

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* Dr. W. E. Arnold, assistant-surgeon U.S. Navy, has kindly drawn my attention to the fact that an amputation, in all essentials the same as Furneaux Jordan's, was performed as long ago as 1806 by Dr. W. Brashear in Bardstown, Kentucky. The following account taken from a letter by Dr. Brashear will be found in Dr. Mott's edition of Velpeau's *Surgery*, in a summary of hip-joint amputations by Dr. Eve, of Tennessee. The patient was a lad, aged 17. An operation on the thigh in the ordinary manner was determined upon, as remote from the hip-joint as circumstances might justify (in this case, about mid-thigh). The amputation was performed and the arteries secured. The great step was to make an incision to and from the lower end of the bone externally over the great trochanter, to the head of the bone and upper part of the socket. The dissection of the bone from the surrounding muscles was simple and safe, by keeping the edge of the knife resting against it. The bone being disengaged from its integuments at its lower extremity, was then turned out at a right angle from the body, so as to give every facility in the operation to separate the capsular ligament and remove the head from its socket. The patient made a good recovery. Judging from a letter from Prof. Ollier to Mr. Shuter (*loc. infra cit.*) the former surgeon had recommended this method in 1859, and performed such an operation once.

Methods.—I. **Furneaux Jordan.** II. **Antero-posterior Flaps.** III. **Lateral Flaps.** IV. **Modified Lateral—viz., Antero-internal and Postero-external—Flaps.**

I. **Furneaux Jordan's Method** (Fig. 226).—By amputating through the thigh as low down as possible, and shelling out and disarticulating the femur, it is now possible to avoid, in large measure, those dangers which were formerly inseparable from the operation—viz.: 1. Shock, the limb being removed much farther from the trunk. 2. Hæmorrhage. *a*. Abundant room is afforded for compression of the common femoral, and the vessels behind. *b*. The large vessels can easily be secured on the face of the stump. *c*. The gluteal and sciatic arteries remain untouched, the hæmorrhage from these, in the older operations, being a source of serious danger. 3. Septic changes. By the other methods, the copious discharge of bloody serum from the large wound,* being poured out close to the anus and genitals, was very liable to infection. By this operation, both the end of the stump and the wound on the outer side can be more easily drained and kept aseptic. In making use of this amputation, especially for hip disease or failed excision, the surgeon should not attempt too much to secure primary union.† 4. The stump is a better one. It is longer, more mobile, and occasionally, as in amputation for acute periostitis or necrosis, it is possible to preserve much of the periosteum from the upper half of the femur, and a cord ‡ will be left which will render the stump movable. Whether in any case an artificial limb can be worn for more than about half an hour at a time is very doubtful.

Methods of Controlling Hæmorrhage during Amputation at the Hip-Joint.

1. *Elastic Compression by Jordan Lloyd's Method* (Fig. 226).—This may be applied at the junction of the limb and trunk, without inter-

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* As will be shown below, the wound in a Furneaux Jordan amputation is also a large one, but much more happily placed for being drained and kept sweet.

† Verneuil (*Paris Acad. de Méd.*, 1877).

‡ The committee of the Clinical Society appointed to examine Mr. Shuter's case of sub-periosteal amputation of the hip-joint reported (*Trans.*, vol. xvi. p. 89), (1) that, though there was a firm, resisting cord of considerable size in the centre, which afforded the muscles a common point of attachment, there was not sufficient evidence to enable them to state that this cord contained bone; (2) that the muscles were in a high state of nutrition, the patient not only powerfully flexing, extending, abducting, and adducting his stump, but being able to communicate all these movements to the artificial limb.

Mr. Shuter in his paper (*loc. supra cit.*) says that his patient was able to wear an artificial limb "for some hours nearly every day for a period of about five months. I then forbad his wearing it for a time on account of a tender sinus which opened opposite to the acetabulum." In the notes of this case, quoted by Mr. Holden in his obituary notice of Mr. Shuter (*St. Barthol. Hosp. Rep.*, vol. xix. p. 38), it is stated that "the stump was sufficient to enable the patient to wear an artificial limb for a time, but he was obliged to leave it off on account of its weight." I have now performed this amputation seven times. Six recovered, and, in one of my three cases in adults, a delicate girl of 22 has been able to wear a very light limb, made by Messrs. S. Maw, Son and Sons, for three hours at a time. In such cases as these, where the patient is much reduced by long-standing hip disease, and the periosteum is still adherent to the wasted femur, it is not, in my opinion, advisable to spend time in stripping it off. While the shock of the hip-joint amputation is much lessened by this method, it cannot, of course, be entirely removed.

fering with the operator, by the following method: While the patient is passing under the anæsthetic, the limb is emptied of blood by elevation and application of Esmarch's bandages as far up as the tissues are healthy; the patient is then rolled over on to his sound side, and a piece of rubber bandage about two yards long, and stout enough to require decided exertion to stretch it out fully, is doubled and passed between the thigh and trunk, its centre lying between the anus and tuber ischii. A white roller bandage of appropriate size is then laid over the termination of the external iliac artery. The ends of the rubber bandage are now to be firmly and steadily drawn in a direction upwards and outwards, one in front of the groin and one over the buttock, to a point above the centre of the iliac crest, sufficient tightness being employed to stop all pulsation in the femorals or tibials. The front part of the band passing over the white bandage occludes the external iliac and runs parallel to and above Poupart's ligament. The posterior part runs across the great sacro-sciatic notch and controls the branches of the internal iliac. If the surgeon is short-handed, instead of the cords being held by an assistant, they may, by means of tapes strongly stitched to them, be thus secured: having been drawn with full tightness up to the centre of the iliac crest, they may be crossed over to the opposite side and tied firmly (over lint) midway between the crest and the top of the great trochanter. If a strong and trusty assistant is forthcoming, it will be better to leave the bandage in his hands, but in the case of an adult whose tissues are not wasted, and on a hot day, the exertion is not a slight one.*

Whether the bandage be held or tied, especial care must be taken that it does not slip from off the external iliac nor over the tuber ischii. It is a good plan to pass the ends of the india-rubber band over a slip of wood, so as to diminish the prolonged pressure on the hands. To prevent the bands slipping down in the way of the surgeon, two loops of tape or bandage may be thus employed: each, about two feet in length, is placed longitudinally, before the elastic band is applied, the one over the groin, the other well behind the great trochanter, the centre of each being where the elastic band will go. When the band has been applied, these form loops by means of which the band is kept well out of the operator's way, both at Poupart's ligament and behind the great trochanter (Jordan Lloyd, *Lancet*, 1883, vol. i. p. 897).

2. *Paul's Method* (*Lancet*, vol. i. 1895, p. 214). This is a modification of the above, the elastic tourniquet being kept in place by means of two strips of calico bandage. One passes under the tourniquet in front and behind, and over the point of the opposite shoulder, the other passes under the tourniquet in the same way and round the opposite hip. Mr. Paul has tested his plan in seven cases, in all of which it acted perfectly satisfactorily.

3. *Macewen's Method of Compression of the Abdominal Aorta* (*Ann. of Surg.*, 1894, vol. i. p. 1).—Prof. Macewen has used the following for many years, and has found it simple, always ready, easily applied

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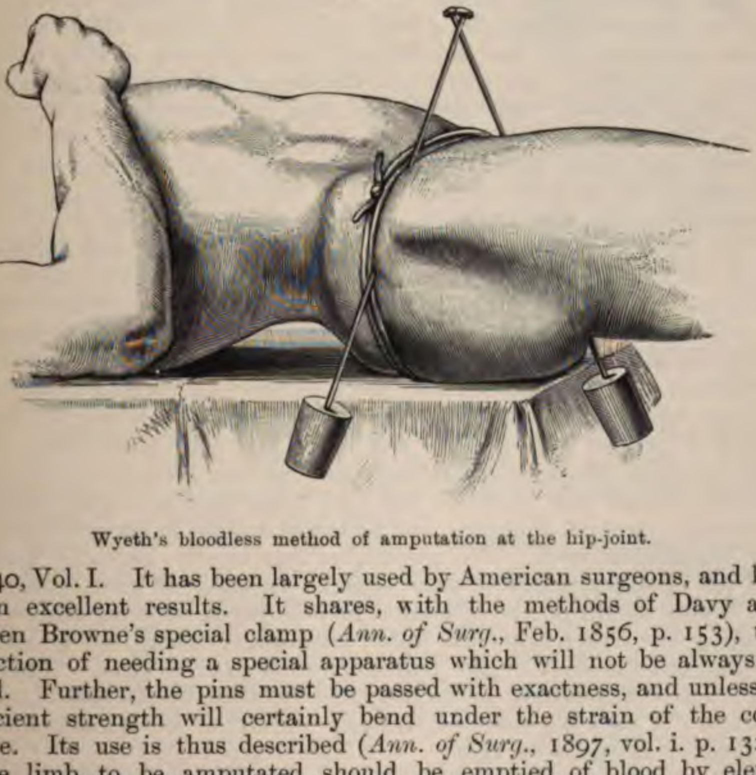
* As will be seen from the description of the operation below, this exertion is only required during shelling out of the femur, a step often simplified by a previous excision. During the circular amputation in the lower third of the thigh, and the securing the large vessels here, there is abundant room to control these by an Esmarch's bandage applied in the usual way.

and efficient. No injury has followed to the small intestines. If the patient vomits or coughs violently, the pressure must be temporarily increased. As the patient lies on his back on the table, the assistant, facing the patient's feet, stands on a stool at the left side of the table in a line with the umbilicus. He then places his closed right hand upon the abdomen, a little to the left of the middle line, the knuckles of the index finger first touching the upper border of the umbilicus so that the whole shut hand will embrace about three inches of the aorta above its bifurcation. The assistant then standing upon his left foot, his right foot crossing his left, leans upon his right hand, and thereby exercises the necessary amount of pressure. With the index finger resting upon the common femoral at the brim of the pelvis, the assistant can easily estimate the weight necessary for the purpose. In this way an efficient assistant can control the circulation for half an hour without fatigue.

4. *Wyeth's Bloodless Method of Amputation at the Hip-Joint.*—I have mentioned this in the account of amputation at the shoulder-joint at p. 140, Vol. I. It has been largely used by American surgeons, and has given excellent results. It shares, with the methods of Davy and Tylden Browne's special clamp (*Ann. of Surg.*, Feb. 1856, p. 153), the objection of needing a special apparatus which will not be always at hand. Further, the pins must be passed with exactness, and unless of sufficient strength will certainly bend under the strain of the cord above. Its use is thus described (*Ann. of Surg.*, 1897, vol. i. p. 132): "The limb to be amputated should be emptied of blood by elevation of the foot, and by the application of the Esmarch bandage, commencing at the toes. Under certain conditions, the bandage can be only partially applied. When the tumour exists, or when septic infiltration is present, pressure should be exercised only to within five inches of the diseased portion, for fear of driving the septic material

FIG. 224.



Wyeth's bloodless method of amputation at the hip-joint.

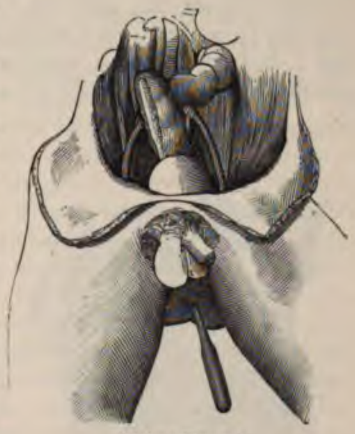
into the vessels. After injuries with great destruction, crushing or pulpefaction, one must generally trust to elevation, as the Esmarch bandage cannot always be applied. While the member is elevated, and before the Esmarch bandage is removed, the rubber tubing constrictor is applied. The object of this constriction is the occlusion of every vessel above the level of the hip-joint, permitting the disarticulation to be completed, and the vessels secured without hæmorrhage and before the tourniquet is removed. To prevent any possibility of the tourniquet slipping, I employ two large steel needles or skewers, three-sixteenths of an inch in diameter and ten inches long, one of which is introduced one-fourth of an inch below the anterior superior spine of the ilium and slightly to the inner side of this prominence, and is made to traverse superficially for about three inches the muscles and fascia on the outer side of the hip, emerging on a level with the point of entrance (Fig. 224.) The point of the second needle is thrust through the skin and tendon of origin of the adductor longus muscle half an inch below the crotch, the point emerging an inch below the tuber ischii. The points should be shielded at once with cork to prevent injury to the hands of the operator. No vessels are endangered by these skewers. A mat or compress of sterile gauze, about two inches thick and four inches square, is laid over the femoral artery and vein as they cross the brim of the pelvis; over this a piece of strong white rubber tubing, half an inch in diameter when unstretched, and long enough when in position to go five or six times around the thigh, is now wound very tightly around and above the fixation-needles and tied. Except the small quantity of blood between the limit of the Esmarch bandage and the constricting tube, the extremity is bloodless and will remain so."

The Esmarch's bandage is now removed and a circular incision is made six inches below the tourniquet joined by a longitudinal incision commencing at the tourniquet and passing over the trochanter major. A cuff including the subcutaneous tissue down to the deep fascia is dissected off to the level of the trochanter minor. About this level the remaining soft parts are divided down to the bone with a circular cut and are rapidly dissected from the femur. The vessels should now be searched for and both arteries and veins tied with good-sized catgut. The muscular attachments are separated so that the capsular ligament may be exposed and divided. The limb being used as a lever, the thigh is forcibly elevated, abducted, and adducted, letting in air and rupturing the ligamentum teres. The tourniquet may now be carefully loosened and all bleeding points at once seized. In cases of great exhaustion Dr. Wyeth would do the operation in two stages, securing the vessels, dividing the femur below the lesser trochanter, closing the wound and turning out the head of the femur about two weeks later. While the 633 cases of amputation at the hip-joint collected by Ashurst showed a mortality of 64·1 per cent., of 69 cases performed in this manner only 11 died—a mortality of 15·9.

5. *Davy's Lever* (Fig. 225).—This ingenious instrument, introduced by Mr. Davy, of the Westminster Hospital, consists of a smoothly-turned rod of ebony-wood or metal, from eighteen to twenty-two inches long, with the rectal end enlarged, bluntly conical, and most carefully polished and graduated, and the other forming the handle.

Oil having been thrown into the bowel, the rectal end is introduced, directed towards the vessel to be compressed, and felt for over the situation of the artery through the abdominal wall. Thus, if the right external or common iliac is to be compressed, the handle is lowered and carried over close to the adductors on the left side, so that its end drops over the artery on the pelvic brim (Fig. 225).

FIG. 225.



(After Davy.)

Mr. Davy (*Brit. Med. Journ.*, 1879, vol. ii. p. 685) claims for his instrument the following *advantages*: (*a*) More perfect control of both external and internal iliacs. (*b*) It inflicts a minimum amount of disturbance on the respiratory movements and the circulatory system. (*c*) It is generally and easily applicable. A strictured rectum is the sole obstacle. [So also would be a short and tight mesorectum.] (*d*) The pressure applied is easily maintained, while the assistant in charge of the lever is out of the way of the operator. (*e*) Its application is quite safe in skilled hands, no injury having ever resulted, and but little pain having been suffered. (*f*) It is cheap and simple. (*g*) It has been successful. Mr. Davy, in his paper above quoted, had records of ten cases in which the lever had been employed; the total amount of blood lost during the ten operations had been under 18 oz., and there had been 80 per cent. of recoveries. *Disadvantages.*—Simple and ingenious as the above method is, it is beyond doubt that it has caused a fatal result from injury to the peritonæal coat of the rectum. It is now likely to be replaced by the Jordan-Lloyd method. On account of the above risk I prefer to meet the hæmorrhage either by the above-mentioned method, or, where this is impossible, by securing the vessels before they are cut (p. 584).

6. *Compressing the Common Femoral or the Termination of the External Iliac* by the fingers or hands, aided, if need be, by a weight. This is only possible in the case of a child, and the assistant thus employed is liable to be in the way of the operator.

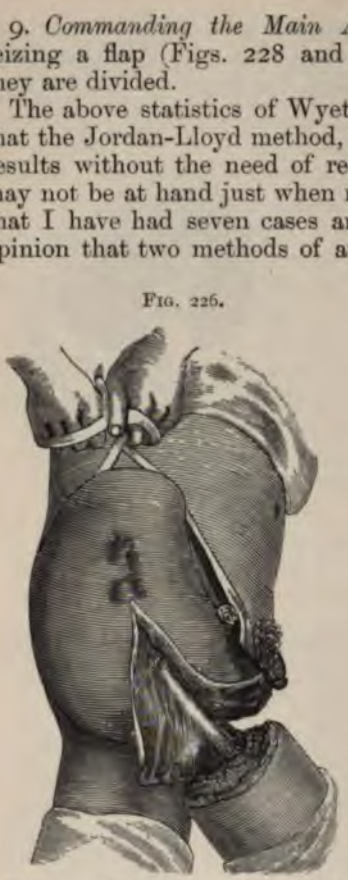
7. *Lister's Tourniquet.*—This means of compressing the termination of the abdominal aorta is not a light matter, apart from the very grave operation into which it enters. This is owing to the difficulty of making sure of avoiding such important structures as the duodenum, pancreas, solar plexus, and small intestines, and to its interference with respiration and circulation. The bowels must be thoroughly emptied beforehand, and got out of the way by gently rolling the patient on to his right side before the pad is applied. In the *Amer. Text-book of Surg.*, p. 1193, two useful hints are given, one to apply a soft sponge between the pad and the skin, and the other to lose not a moment in putting catch-forceps on the chief bleeding points after the main vessels have been tied, so that the tourniquet may be promptly loosened.

8. *Compression of the Common Iliac through an Abdominal Incision.* (Dr. C. McBurney, *Ann. of Surg.*, Aug. 1894, p. 181).

9. *Commanding the Main Artery* during the operation either by seizing a flap (Figs. 228 and 229), or by securing the vessels before they are divided.

The above statistics of Wyeth's method are very good, but I believe that the Jordan-Lloyd method, if carefully carried out, will give as good results without the need of relying on any special instruments which may not be at hand just when required. In support of this I may say that I have had seven cases and only lost one. I am very strongly of opinion that two methods of arresting hæmorrhage here will be found sufficient for all cases. 1. Furneaux Jordan's amputation, aided by the Jordan-Lloyd's method of compression (p. 579). This will suffice for all cases of hip disease which form the great majority of cases calling for amputation here. 2. In the much smaller class of accident or growths by using Prof. Macewen's method (p. 580) and by securing the vessels before they are cut, the flaps being made according to the need of the case. In every case of amputation at the hip-joint shock should be met by making a saline infusion while the amputation is being performed.

FIG. 226.



Furneaux Jordan's amputation. Above is shown the means of controlling hæmorrhage described at p. 579. Lower down are seen the sinuses of an unhealed excision, and the method of shelling out of the femur, after a circular amputation has been performed, and the large vessels secured.

Furneaux Jordan's Operation (Fig. 226).—Every provision must be taken against shock. The limbs should be bandaged in cotton-wool, the body well wrapped up on a hot-water table, the head kept low, ether given, stimulant rectal injections kept at hand, and subcutaneous injections of brandy and strychnine given from time to time.

Before commencing the circular amputation, I have the limb elevated, an Esmarch bandage applied up to the knee, the thigh emptied of venous blood by firm stroking, and a second Esmarch bandage then applied firmly just below the trochanters, and the lower one removed. The india-rubber band is also (p. 579) placed, lightly, ready *in situ*. The circular amputation is then performed, and the large vessels secured. The upper Esmarch is next removed, and the india-rubber band firmly tightened while the femur is shelled out or, perhaps, disarticulated.

The patient's pelvis is brought to the edge of the table and the body rolled a little on to the sound side, the surgeon standing usually to the right of the diseased limb—*i.e.*, inside on the left and outside on the right side—draws up the soft parts forcibly with his left hand, and makes a circular incision through the lower third of the thigh, using his knife as at p. 624, the assistant who is in charge of the limb rotating it so as to make the tissues meet the knife. A circular cuff-like flap of skin and fasciæ is then quickly raised for about two inches and a half,* an assistant, who stands opposite the surgeon, giving much help here, by seizing and everting the cut edge of the flap as the surgeon raises it. The flap being drawn upwards out of the way, the soft parts are severed by one or two vigorous circular sweeps down to the bone, and the large vessels and any others that can be seen are next secured. Pressure † is now made with sterilised sponges on the still oozing wound, and the patient being rolled well over on to his sound side, the surgeon cuts along the outer side of the thigh, starting from the circular wound and ending about midway between the iliac crest and top of the great trochanter. This incision goes straight down to the bone and runs into any excision wound, or sinuses which may exist over the joint. The soft parts are then rapidly stripped off the femur, partly with the knife, partly with the finger, the only difficulty met with being along the linea aspera. If an excision has been performed, the operation is rapidly completed, but if the head and neck remain intact, the final steps will be rendered more difficult, and the joint must be opened from the outside by cutting strongly on the neck of the bone, this being facilitated by the assistant moving the limb, in accordance with the surgeon's directions, as different parts require to be put on the stretch, strong outward rotation of the femur and dragging of the head away from the acetabulum being required at the last.

Free drainage must be provided, for it must be remembered that the wound left by this method is a very large one, though it has the advantage of being farther removed from sources of sepsis. Thus, especially if the tissues are riddled with sinuses, too much of the wound must not be closed, and, if shock is present, the surgeon must not wait to insert many sutures, but, trusting to firm bandages over an aseptic dressing, get his patient quickly back to bed. If disease of the acetabulum be present the surgeon will, if the patient's condition admit of it, attend to this, the use of a sharp spoon (Fig. 237) and the insertion of a drainage-tube through this bone being specially required if pelvic suppuration be present.

In some cases shock is marked from the beginning of the operation. This was most markedly the case in one of the patients mentioned in the footnote, p. 579, a very delicate young lady of 22. It was only by not waiting to do more than secure the femoral, making firm sponge-pressure on the flaps, tilting up the end of the table so as to keep the head low, inserting no sutures, but trusting only to firm bandaging over dry gauze dressings, that a fatal result was averted.

Amputation by Different Flap Methods.—The following will be given here, it being understood that in no case can any of them be recommended if Furneaux Jordan's method is available:

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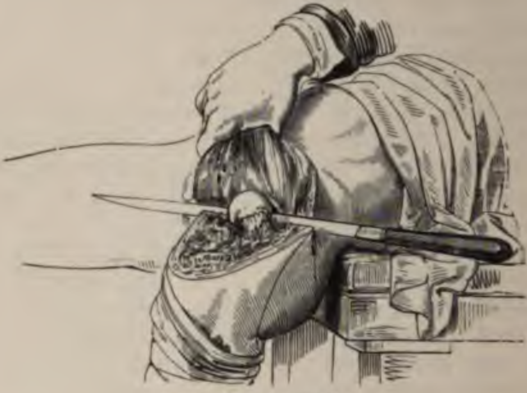
* The surgeon need not trouble to raise a larger circular flap. As the femur is removed, the muscles lose their fixed point to contract from, and are thus easily covered.

† Valuable time should not be wasted in trying to secure every bleeding-point either now or later.

II. **Antero-posterior Flaps** (Figs. 227–230). **Methods of Guthrie and Liston.**—The patient having been prepared against shock (p. 584), and the main vessels secured by one of the methods already given, the limb being brought over the table and supported in the semi-flexed position by an assistant, while the opposite limb is secured over the table by a bandage, the surgeon, standing outside the left and inside the right limb, raising the tissues in front of Scarpa's triangle with his left hand, enters his knife (*e.g.*, on the left side) midway between the anterior superior spine and the top of the great trochanter, and sends it across the limb so that it emerges close to the tuberosity of the ischium. In traversing the limb the knife should pass as close to the capsule as possible, so as (1) to get behind the large vessels, and (2) to

FIG. 227.



(Fergusson.)*

FIG. 228.

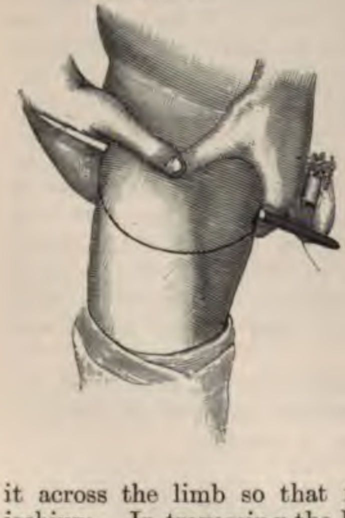
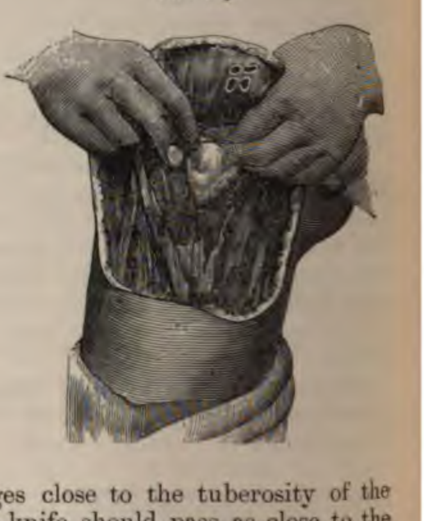


FIG. 229.



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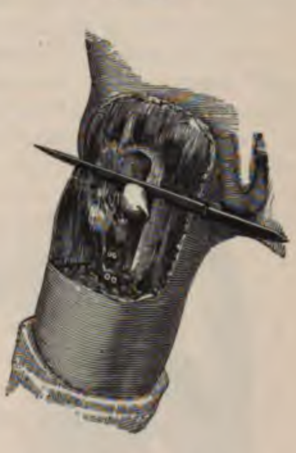
* The knife represented here is needlessly long.

facilitate the opening of the capsule later on. As the knife emerges the surgeon will, of course, be careful of the scrotum and the opposite thigh, and at this moment the point should be well depressed, so as to include all the tissues possible in the anterior flap. With a rapid sawing movement a broad flap is cut, five inches long, an assistant thrusting his fingers into the wound as it is made, and following the back of the knife, to secure the large vessels (Figs. 228, 229). As he then draws up the anterior flap the capsule is exposed, covered with more or less of soft parts, according to the skill with which the knife has been first inserted; the assistant in charge of the limb at this moment extending, depressing, and rotating out the femur, so as to put the capsule on the stretch, the surgeon forcibly draws the knife across the capsule, opens it freely, and divides the ligamentum teres (Fig. 230).

FIG. 230.



The limb being now slightly flexed, adducted, and pulled away from the body, the surgeon severs the parts attached to the great trochanter and the outer aspect of the limb, and, passing his knife behind the bone, cuts a posterior flap about four inches long. The assistant in charge of the limb will facilitate this step, and further the dislocation of the femur, if he bring the thigh upwards and forwards with one hand placed at the back. A large gauze pad wrung out of one-in-twenty carbolic acid is at once pressed against the posterior flap while the femoral vessels* are secured, or, if these are well in hand, those in the hinder flap are taken first. The glutæal will be found in the glutæal muscles, the sciatic with the nerve nearer the posterior margin of the flap, and the circumflex and obturator closer to the acetabulum.

If the patient's condition admits of it, any sinuses are now laid open or scraped out, the acetabulum examined, and, if perforated, drained. If the amputation has been for growth, any outlying masses are looked for and removed. Any nerves or muscles which need it are now trimmed short, a large drainage-tube inserted, and the flaps carefully united.†

Advantages of this method: Chief of these is its rapidity.—*Disadvantages:* 1. The hæmorrhage which takes place from the vessels from the posterior flap may be considerable. 2. The large amount of sero-sanguineous oozing which takes place from so many large muscles cut obliquely. 3. The fact that, in an adult, it requires a special, long knife, not always found in an ordinary collection of instruments.

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* Of these the femoral lies superficially, the profunda more deeply, in the anterior flap; they are shown much too close to each other in Fig. 229.

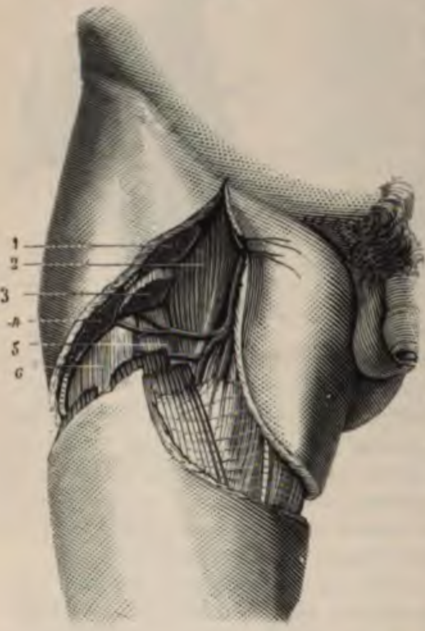
† If grave shock is present, the head should be lowered and sutures put in, any oozing being stopped by firm spica-bandaging, and Spencer Wells's forceps left *in situ*. The lower end of the bed should be kept raised, and brandy given subcutaneously and per rectum. Transfusion should also be employed early (p. 584).

Difficulties: 1. Not passing the knife deeply enough, and thus not exposing the capsule. 2. Passing the knife too deeply, and hitching its point on the bone. 3. Getting the knife stopped in passing it behind the head of the femur. 4. Fracture of the femur.

Guthrie's Method by Antero-posterior Flaps.—Antero-posterior flaps are again made use of, but here they are made from without inwards, and thus can easily be rendered less bulky. A small knife—*i.e.*, one four inches long—suffices.

The preparatory steps being taken as before, the surgeon, standing on the right side of either limb, marks out his anterior flap, about five inches long, by an incision, starting (on the left limb) from just above the great trochanter, passing across the thigh with a broadly curved convexity, and ending just below the tuber ischii. A posterior flap is then marked out by carrying the knife in a similar manner across the back of the limb between the same points, the limb being raised and the surgeon stooping somewhat. This flap should be about two-thirds the length of the first. Both consist of skin and fasciæ. The flaps being held out of the way, the muscles, first on the front and then on the back, are next cut obliquely from below upwards, the femoral vessels, both superficial and deep, being secured as soon as they are exposed, and before they are cut, either by underrunning them with an aneurysm-needle loaded with silk, or by dividing them between two pairs of forceps. The capsule being exposed, disarticulation is performed as before.

FIG. 231.

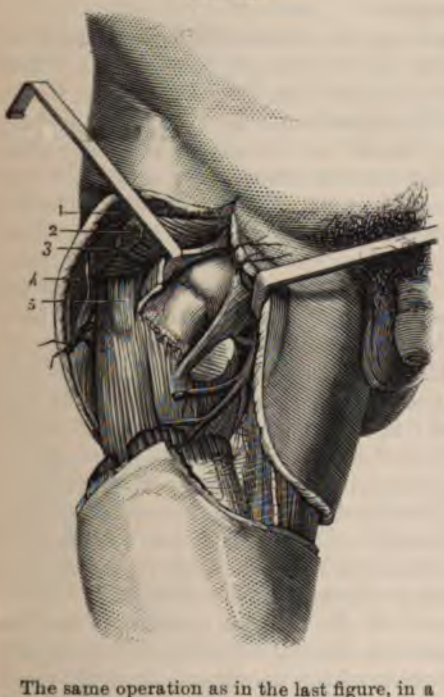


Amputation at the hip-joint by modified lateral flaps (anterior racquet-shaped incision). 1, The sartorius. 2, The ilio-psoas. 3, The rectus. 4, The tensor vaginæ femoris. These have been cut and retractors have exposed (5 and 6) the internal and external vasti. A double ligature has been placed upon the common femoral vessels. (Farabeuf.)

III. Lateral Flaps.—The methods of Larry and Lisfranc need not be more than alluded to here. In both, the flaps were cut by transfixion, and were about four inches long. Larry tied the common femoral as a preliminary step. Flaps made by either method are so bulky as not to be recommended.

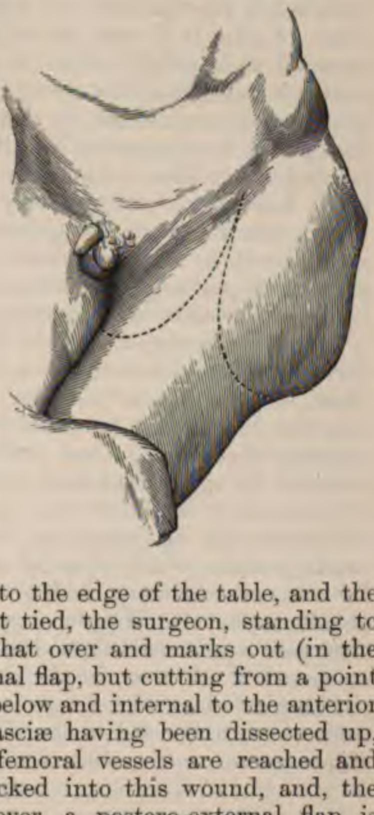
If the surgeon wishes to use lateral flaps, as in a case involved by growth in front, he may make them, thus, from without inwards: Standing on the right side of either limb, he, *e.g.*, in the case of the right limb, marks out an inner flap by means of an incision starting from below the tuber ischii, carried downwards along the inner aspect of the thigh for about four inches and then curving upwards to the centre of the groin and ending, a little below Poupart's ligament, to the outer side of the femoral vessels; next, without taking off his knife, he marks out an outer flap by cutting between the same points, but in the reversed direction. This incision, as it passes downwards, outwards, and backwards, should leave the front of the limb about a hand's-breadth below the great trochanter. The flaps having been dissected up, the soft parts are cut through from without inwards, the femoral vessels being secured before they are cut, and disarticulation performed last.

FIG. 232.



The same operation as in the last figure, in a more advanced stage. The capsule has been opened and its outer lip drawn aside by a retractor. The other retractor draws inwards and protects the vessels. 1, Sartorius. 2, Psoas. 3, Rectus. 4, Tensor vaginæ femoris. 5, Attachment of glutæus minimus. (Farabeuf.)

FIG. 233.



IV. **Antero-internal and Postero-external Flaps** (Figs. 231, 232, 233).—This is a modification of the last method, and may be useful in cases of growth extending high up, where it is impossible to perform a Furneaux Jordan's amputation. Some such flaps as the above may be the only ones obtainable. They may be made as follows: The precautions as to shock given at p. 584 having been taken, the patient's pelvis having been brought well down to the edge of the table, and the opposite limb being held aside but not tied, the surgeon, standing to the right of either limb, reaches somewhat over and marks out (in the case of the right limb) an antero-internal flap, but cutting from a point close to the tuber ischii to one a little below and internal to the anterior superior iliac spine. The skin and fasciæ having been dissected up, the muscles are cut through till the femoral vessels are reached and secured. Sterilised gauze is now packed into this wound, and, the patient having been rolled a little over, a postero-external flap is marked out and dissected up from the glutæal region, passing between the above points, but in the reverse order. The glutæal vessels are next cut through, the chief vessels being secured by Spencer Wells's forceps; the capsule is then opened, the round ligament severed, and the limb removed.

EXCISION OF THE HIP.

Indications.—A. Disease. B. Injury, especially gunshot.

A. **Disease.**—The value of excision here has been much disputed. The chief questions are: **Does it save life? Does it shorten treatment? Is the limb a better one?**

To take two of the chief writers on hip disease and the subject of excision, Mr. Howard Marsh,* with his experience gained from Great Ormond Street and the Alexandra Hospital for Hip Disease in Childhood, and Mr. G. A. Wright,† of Manchester and the Pendlebury Hospital for Sick Children. Mr. Marsh is strongly against excision, for these reasons: He considers the results obtained by continued rest to be such as to render excision totally uncalled for. Thus, continued rest gives a mortality of only 5 per cent., 70 per cent. of the cases thus treated recovering with only slight lameness and loss of movement. Even when suppuration has occurred, the mortality is only 6 or 8 per cent. Again, at p. 309, Mr. Marsh writes: "The estimate that I have been led to form is, (*a*) that, in the early stage of the disease, although matter is developed, the operation is as unjustifiable as it is to remove a testis, an eye, or a tooth for incipient but still curable disease; (*b*) that the operation is generally uncalled for, even when sinuses have formed; (*c*) that if hip disease has been allowed to reach the stage in which the bones have become extensively carious, in which matter has burrowed widely, and in which the general health has become seriously affected, excision will be of very doubtful benefit. The operation will be fatal in at least 10 per cent. of the cases, while in another 20 or 25 per cent. it will be followed by no improvement in the patient's condition."

On the other hand, my old friend, G. A. Wright, speaking from the very large experience of over a hundred cases of excision, of which only three, at most, died of the direct results of the operation, strongly urges that the hip should be excised "as soon as there is any evidence of external abscess, . . . and still better results would, I believe, be obtained by operating before the pus has escaped from the articulation. The operation is discredited because it is put off until disease is so far advanced that no treatment can have more than a fraction of good results; while timely excision cuts short the disease, saves pain, lessens the time of treatment, and gives a better limb." And again, at p. 97 of his book, Mr. Wright says: "While fully aware that abscesses disappear and tuberculous lesions cicatrise under favourable circumstances, I think that, in the case of the hip, delay is unwise amongst the hospital class, with whom it is as yet impossible to deal on the same lines as with the well-to-do. In almost every instance I have found much more extensive disease than might be expected from the external evidence, unless the pathology of the affection is borne in mind; and I believe that, once this chronic osteo-myelitis is established, nothing short of excision can, *in hospital cases*, prevent the ultimate progress of the disease to abscess, and too often to gradual exhaustion of the patient by pain and discharge. Nature, of course, in many cases will, unaided, get rid of the dead bone by slow and tedious processes, but the number of children who can survive the process of elimination is very small, while the mortality after early excision is not great, and the failures are mainly in those instances where the operation has been put off till too late. Where actual necrosis, or caries of the head of the femur, with destruction of bone and cartilage, and often sequestra of varying size in the acetabulum, or at least caries of it, are known to exist, I think few advocates of non-operative treatment will be found." With reference to so wide a divergence of opinion between two authorities on the subject, it may be pointed out that Mr. H. Marsh worked under conditions more favourable than those which fall to the lot of most hospital surgeons. Thus, at the Alexandra Hospital, cases are kept under treatment as long as rest and extension are required; if an operation is called for, the case is transferred elsewhere. While everyone must admire Mr. Marsh's success, it is clear that the conditions under which it has been gained must, as yet, stand almost alone.

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* *Diseases of the Joints*, p. 317.

† *Hip Disease in Childhood*, p. 93.

Reference must here be made to a most important contribution to the study of the treatment of hip disease by Drs. Gibney, Waterman, and Reynolds, of New York (*Ann. of Surg.*, vol. ii. 1897, p. 435). An analysis is given of 150 cases treated at the New York Hospital for Ruptured and Crippled. Of these 25 were still under treatment, and need not be further considered; 7 were advised readmission for deformity, 11 died, and 107 were cured. The 107 cured cases were finally examined at an interval of five to twenty years after leaving the hospital. The excellence of the final result in the cured cases, all of which recovered with sound and useful limbs, will be gathered from the following facts. As regards motion, this was perfect in 15, good in 22, limited in 41, and absent in only 9 cases. Shortening averaged an inch and three-fifths in all the cases, but was absent in 21 cases; under one inch in 71, and over one inch in 36. The record as regards flexion is also extremely satisfactory, as 47 cases had none at all, and in 77 it was under 10°; in the remaining 30 cases it was under 30°. The treatment employed consisted essentially in rest and extension; abscesses being either aspirated, or opened and curetted. Osteotomy of the femur was performed 19 times to correct deformity, but excision was done in 4 cases only.

Briefly stated, of 114 cases examined five years and upwards after leaving the hospital, 107 "were cured and able to follow an occupation without the slightest trouble," and the remaining 7 cases were cured but suffering from considerable deformity. As excision was performed in only 4 of these cases, it must be admitted that these excellent results constitute very strong evidence in favour of the conservative treatment advocated by Mr. Marsh.

My own opinion as to the advisability of excision in the ordinary hip disease of hospital children is, that it should be resorted to (1) when suppuration is present, and persists in spite of a fair trial of rest, and antiseptic incision, this latter step giving an opportunity, though a limited one, of investigating the amount of disease present; (2) when there is much thickening about the great trochanter; and (3) when there is much pain, especially at night, not yielding to a due trial of rest. But while I should thus advocate the performance of the operation in the second stage, I think that sufficient importance has not been attached to the fact that disease of this most important joint is, unless not only seen but treated in the first stage, severe and progressive, and, *per se*, likely to end fatally; if this be so, excision must not be too much reproached with failure. The depth of the joint, the needful interference with soft parts, the difficulty of keeping the wound aseptic in children, the kind of patient, and the tubercular origin of the disease, must always be remembered. For these reasons I cannot quite agree with G. A. Wright (*Dis. of Children*, p. 558), "that excision," as soon as suppuration and other evidence of necrosis is present, "should be looked on as an ordinary operation for necrosis, and the operation itself is not necessarily attended by a higher mortality than sequestrotomy elsewhere."

The following are the conditions given by the Clinical Society's Committee on excision of the hip-joint as calling for excision, viz.:—

i. "Necrosis, and separation of the entire head of the femur, and its conversion into a loose sequestrum."*

ii. "The presence of firm sequestra either in the head or neck of the femur, or in the acetabulum." This question is a most important one, for, as Mr. Marsh (p. 318) writes, "much difference of opinion exists as to the frequency with which hard sequestra of any material size are present in suppurative hip disease." He himself thinks that, when present, sequestra usually consist of porous, friable bone. Their structure is such that, should excision not be performed, they will crumble away and disappear, and will not prevent repair.† A distinctly different opinion is held by Mr. Wright (*loc. supra cit.*, p. 118): "Here opening of abscesses, and, still less, expectant treatment, can hardly be considered a satisfactory mode of getting rid of sequestra, yet in no less than in 39 (out of 100) were there actual loose sequestra, while in many others there were patches of bone which was practically dead, though not loose. The possibility of removing sequestra without a formal excision is worth trying in some cases, but it is often impossible to discover the presence of the sequestra until the end of the bone has been removed, or to extract them if found. Moreover, even after the removal of sequestra, others may exist and not be found, and in other instances the disease progresses in the surrounding bone and necessitates subsequent excision. There are often, too, other foci of disease in the medulla, which are as great bars to recovery as the sequestra themselves."

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* Mr. Marsh (*loc. supra cit.*, Fig. 50, p. 383) thinks that these cases are not rare. Mr. Hilton (***Rest and Pain***, Fig. 63, p. 341) shows a similar specimen. I should have thought the condition a very uncommon one.

† "This seems to be proved by the fact that in numerous cases in which profuse suppuration has been going on, so that there can be no reasonable doubt that extensive bone disease has been present, all the sinuses will close, although either no bone has worked out or been extracted. In these instances we must conclude either that no sequestra were present, and in that case it would appear that sequestra are not so common as some believe, or that they often crumble away and are discharged, so that operative interference is by no means essential for their removal" (Marsh, *loc. supra cit.*, p. 319).

iii. "Extensive caries of the femur, or the pelvis, leading to prolonged suppuration and the formation of sinuses."

iv. "Intra-pelvic abscess following disease of the acetabulum."

With reference to these conclusions I should doubt myself whether excision can be often justifiable, especially in the latter. Even if it gave the desired drainage the patient's condition with disease of the acetabulum is not one usually to give the required repair after excision. "Extensive caries" of the pelvis certainly, and in many cases of the femur, will require amputation, especially after childhood.

v. "Extensive and old-standing synovial disease and ulceration of the articular cartilages, with persistent suppuration." This condition is rarely seen in the hip-joint, where the disease, as usually met with, starts not in the synovial membrane, as in the knee-joint, but as a chronic osteo-myelitis in the neighbourhood of the epiphyses, especially the upper one.

vi. "Displacement of the head of the femur on the dorsum ilii, with chronic sinuses and deformity."

This condition will probably be more rarely met with nowadays, as earlier facilities for treating hip disease arise. I happen to have performed excision seven times for such cases; of these six recovered with sound and useful limbs, but in one, a lad of 18, in which the sinuses had closed some years before the operation, I should now prefer to improve the condition of the limb by a Gant's osteotomy and division of the contracted sartorius, tensor vaginæ, and adductor longus. These patients seem to me to bear excision well, this being probably due to their having good vitality, as shown by their survival, and the amount of repair. Further, in running successfully the gauntlet of the disease, they have escaped the dangers of lardaceous and general tubercular trouble. The surgeon here must, if he excise, be prepared for a good deal of trouble in dislodging the displaced head, after sawing through its neck, owing to its being firmly matted down by old adhesions.

The Condition of the Limb. Is this a better one after Excision or after a Cure by Rest?

Here, again, there is marked divergence of opinion, Mr. Marsh (*loc. supra cit.*, p. 308) is of opinion that "the limb after excision of either the hip or the knee is usually very inferior to the average limb that is obtained after recovery has followed the treatment by rest." Mr. Holmes (*Syst. of Surg.*, vol. iii. p. 757, 1883) thinks that, while recovery after excision of the hip-joint is very complete as far as the movements of the limb are concerned, "the shortening is generally greater than after the spontaneous cure, and the limb is less firm, and, on the average, less useful." The Clinical Society's Committee reported on this subject that, after excision, "movement is more frequently present, and is also more extensive, but that patients often walk more insecurely and with a considerable limp, while the limb, after treatment by rest and extension, though frequently more or less fixed, is more firm and useful for the purposes of progression." While feeling assured that the resulting usefulness in *some* cases treated by excision far surpasses the best results obtained by rest, I consider that the *average* result obtained by rest is superior to that following excision, and that this is increasingly marked after childhood, the limb, especially in adolescents recovering after excision, being very often flail-like and useless.*

On the other hand, Mr. Wright, whose large experience on this subject has already been referred to, has come to the conclusion (*loc. supra cit.*, p. 126) that "excision gives a better limb than the average result obtained without operation;" and again (p. 114): "In my own experience, useless, flail-like joints are exceedingly rare, and limited to those cases where the excision was performed in very late stages of the disease; the powerless condition is, I take it, the result of the disease, not of the operation." With regard to the two conditions which chiefly interfere with the usefulness of the limb after hip-excision—viz., a flail-like state, and shortening—Mr. Wright's opinion on the former has already been given. With regard to the latter, he considers (p. 108), that "though some shortening must necessarily result, this arises mainly from the weight being borne upon the limb prematurely. . . . . Growth in length of the femur takes place almost entirely at its lower epiphysial line, hence the loss of length or true shortening is only the distance from the line of section of the top of the head, coupled with such arrest of growth as may result from impaired nutrition, this last being, of course, a very inconstant quantity." †

Mr. Barker, in giving an analysis of the after-history of forty-one cases of excision by the anterior method (*Lancet*, 1900, vol. i. p. 1499), also speaks favourably of the final result. He says: "As to functions of the limbs operated on, as seen (in all cases but two) years after, they were excellent."

Conditions of Success in Excision of the Hip.—Amongst these are: 1. Age. I consider the best six to fourteen. After eighteen excision should rarely be performed, Furneaux Jordan's amputation taking its place. Mr. Wright (p. 126) thinks that after fifteen excision should be rejected in favour of amputation. 2. Absence of lardaceous disease. I cannot agree with the conclusion of the Clinical Society's Committee (*loc. supra cit.*, p. 233), that excision is called for, "when, in a case of suppuration, enlargement of the liver and albuminuria, indicating the presence of degeneration of the viscera, is detected." Excision should be performed, in my opinion, only before the appearance of lardaceous disease. When there is evidence of this condition having set in, especially in the kidneys or intestine, amputation is to be preferred. 3. Absence of advancing mischief in other joints, or of tubercular lesions in the viscera—*e.g.*, the lung. 4. The disease must be removed as entirely as possible. Thus, in the femur at least, the section must pass below all foci of disease. All sinuses should also be scraped out. 5. Adequate drainage. 6. Careful after-treatment, the wound being kept aseptic. 7. The patient must not be kept too long on his back in hospital air.

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* Prof. Bruns, of Tübingen (*loc. infra cit.*), is of opinion that in the preservation of function the balance is greatly in favour of the conservative treatment as opposed to resection.

† On this matter Mr. Wright quotes Prof. Ollier's (*Rev. de Chir.*, 1881; *Annals of Surg.*, Jan., 1886) estimate that, up to five years of age, the growth of the femur takes place about equally at its two ends; that, after five, the rate of growth of the lower end increases rapidly till it becomes three times that of the upper.

B. Gunshot Injuries.

Excision of the Hip-joint for Gunshot Injuries, contrasted with Conservative Treatment, and Amputation at the Hip-joint.—For the sake of convenience it will be well to take the above three plans of treatment of gunshot injuries of the hip together. As before, I shall avail myself of the laborious researches and the unrivalled authority on this subject of Dr. Otis. He writes (*Med. and Surg. Hist. of the War of the Rebellion*, pt. iii. p. 165) that the evidence collected during the American war shows that "of the cases of undoubted intra-capsular shot-fracture of the hip treated by conservation, 98·8 per cent. had a fatal termination, that in sixty-six cases treated by excision, the fatality was 90·9 per cent., and that in sixty-six cases treated by exarticulation, it was 83·3 per cent.; but from these results it should not be concluded that operative interference was always indicated, and that amputation was preferable to excision. On p. 121 of *Circular* No. 2, I have already pointed out that the question as to the most eligible treatment of shot injuries of the hip-joint is not susceptible of a purely arithmetical solution, and that the variety of the conditions under which the patients are placed, the diversity in the extent of their injuries, and the inevitable imperfection of all surgical records, forbid any such rigorous comparison. No less than nine of the sixty-six cases of excision were complicated with such lesions of the pelvic walls and viscera as made any operative interference useless; among the sixty-six coxo-femoral amputations, probably all successful cases have been recorded, while some fatal cases may remain unpublished, and in the 304 cases treated by conservation, the correctness of the diagnosis may be questioned in many instances. The character of the injury must determine the choice of treatment; but the general rules regarding shot wounds of the hip-joint laid down in *Circular* 2 are uncontroverted: that expectant treatment is to be condemned in all cases in which the diagnosis of direct injury to the articulation can be clearly established," that "primary excisions of the head or upper extremity of the femur should be performed in all uncomplicated cases of shot fracture of the head or neck;" that "intermediary excisions are indicated in similar cases where the diagnosis is not made out till late;" that "secondary excisions are demanded by caries of the head of the femur or secondary involvement of the joint;" that amputation should be performed—"1. When the thigh is torn off, or the upper extremity of the femur comminuted with great laceration of the soft parts, in such proximity to the trunk that amputation in continuity is impracticable. 2. When a fracture of the head, neck, or trochanters of the femur is complicated with a wound of the femoral vessels. 3. When a gunshot fracture involving the hip-joint is complicated by a severe compound fracture of the limb lower down, or by a wound of the knee-joint."

It is possible that Dr. Otis's opinion as to the uselessness of expectant treatment in gunshot injuries of the hip-joint will need alteration in the future—*i.e.*, Prof. Langenbeck,* from his experience in the Franco-German war, considered that the expectant treatment gave a larger proportion of recoveries than excision, and still more than amputation, and advised that the expectant method should always be resorted to save when disarticulation is rendered inevitable by the destruction and shattering of the limb. Sir T. Longmore (*Syst. of Surg.*, vol. i. p. 561), thinks that this question must be held to be still "*sub judice*, and surgeons must wait for still more extended experience under modern improved methods of treatment, before any rule can be accepted as having yet been established on this grave question."

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* *Arch f. Klin. Chir.*, 1874, Bd. xvi. S. 309–316. The recoveries seem to twenty-five out of eighty-eight cases so treated.

Examining into the dates at which the excisions of the hip were performed, Dr. Otis (*loc. supra cit.*, p. 126) gives the mortality rate at 93 per cent. for the primary, 96·6 per cent. for the intermediary, and 63·4 per cent. for the secondary operations. Thus, "the excisions and amputations practised during the intermediary or inflammatory stage are by far the most dangerous, and should never be performed except as compulsory operations."

As to the dates of the exarticulations of the 254 cases, there were 82 primary, with 75 deaths (91·4 per cent. mortality); 55 intermediary, with 52 deaths (94·5 per cent.); 40 secondary, with 33 deaths (82·5 per cent.); re-amputations, with 4 deaths (36·3 per cent.). Dr. Otis shows from these statistics that "intermediary operations offer the least chance of recovery, that the results of primary operations are more favourable; that secondary exarticulations give one recovery in twelve cases; and that of the instances of re-amputation one in about three proves successful. . . . Unless the nature of the injury is such that the operation can be delayed till the secondary period, it is better that it should be done at once, although it would appear that the dire results of amputations at the hip performed during the Schleswig-Holstein war of 1864, the Austro-Prussian war of 1866, and the Franco-Prussian war 1870-71, have had a tendency to raise doubts regarding the expediency of, especially the primary, exarticulation of the hip."

Very probably the results of these injuries in the Boer war, when published, will be found to differ widely from those given above; in consequence chiefly of the difference in the projectile and of the greatly diminished frequency of septic infection.

Operation.—Two will be described here: A. **By Posterior Incision**; B. **By Anterior Incision.**

A. **Posterior Incision** (Figs. 234, 235).—The chief advantage of this is its better drainage, a point which is of less importance nowadays, and which no longer outweighs, in my opinion, the smaller interference with muscles entailed by the incision in front (p. 599).

While the patient is being brought under ether, a stirrup is applied if weight-extension is to be made.* The child being rolled over on to his sound side, and the parts thoroughly cleansed, the surgeon stands usually outside the limb, the patient's body being in either case placed conveniently at the edge of the table, one assistant supporting the limb, while another is opposite to the surgeon. An incision, about three inches and a half long,† is now made over the middle‡ of the great trochanter, commencing about midway between the top of this bone and the posterior superior spine, and ending over the shaft, just below the trochanter. The incision should curve slightly forwards and pass down to bone or cartilage, as the case may be, at once. Any bleeding vessels having been secured, the exact position of the head and neck is now made out by the finger, aided by an assistant rotating the limb. A second incision opens the capsule freely. With a periosteal elevator, aided by a knife, the muscles attached to the great trochanter are

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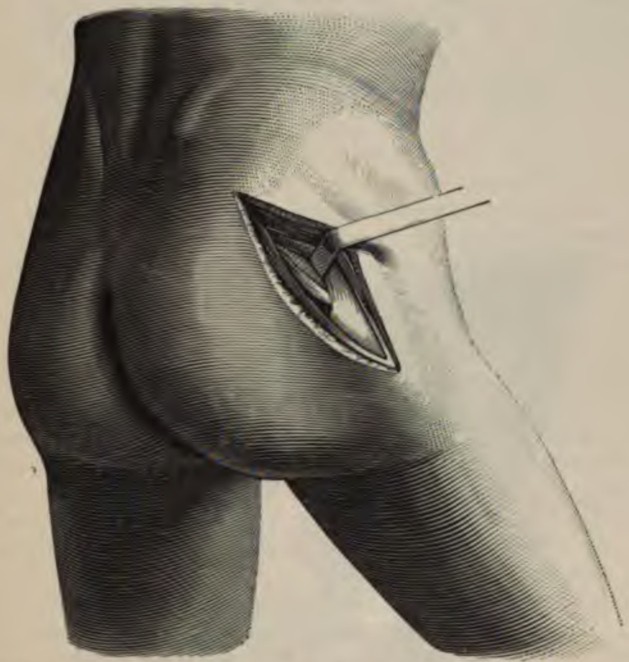
* There is no occasion to apply an Esmarch's bandage above the wound; and rendering the limb evascular, save by elevation, is often rendered impossible by the presence of an abscess or sinuses.

† This is usually sufficient in a child. But it must be always remembered that a small wound, by giving insufficient room, leads to bruising and difficulty.

‡ The advantage of going as far forward as this is, that the fleshy and vascular parts of the muscles attached to the great trochanter are better avoided.

FIG. 234.



Resection of the head of the femur by the posterior incision. The thigh is flexed to an angle of 45°. The glutæus maximus has been divided, allowing the great trochanter to come into view. The retractor draws aside the skin, the upper part of the glutæus maximus, and the medius. Below it is the pyriformis. (Farabeuf.)

detached, the cartilage in young subjects peeling off with them in one or more pieces. The finger is now passed round the neck of the femur and the soft parts, including the periosteum, detached as much as possible on the inner side. The finger, now feeling that the upper part of the trochanter and the neck of the bone are free, and protecting the soft parts on the inner side, the bone is sawn through just below the top of the trochanter with an osteotomy, metacarpal, or keyhole saw.*

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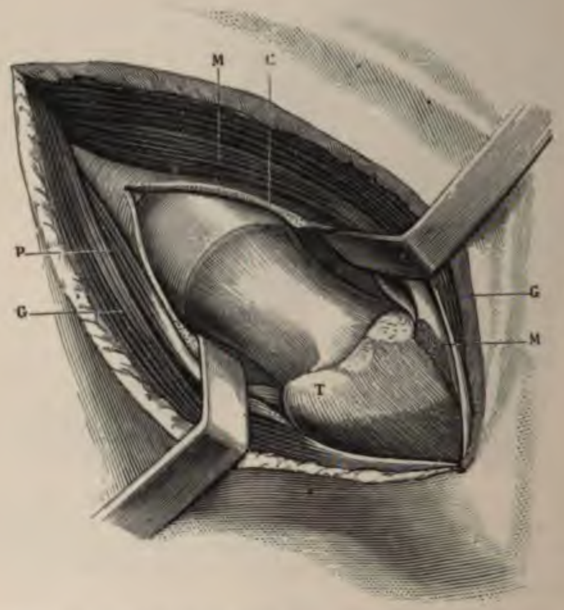
* The section of the bone should always be made while this is *in situ*. The plan of dislocating the head by adducting the limb, and then sawing it off, disturbs the parts more, and runs the risk of fracturing the wasted femur of a little child, an accident which I have seen occur in the hands of a very careful operator. Mr. Wright (*loc. supra cit.*, p. 101) states that he had one case among his earlier operations, and
he has also separated the lower epiphysis in an infant while manipulati
during incision of the joint. He points out another objection—viz.
which the periosteum may be stripped off if the head of the bor

This division should be thoroughly and cleanly effected without splintering. If it be preferred, in addition to the protection of the finger on the inner side, a blunt dissector may be passed behind the bone, but this is not essential: retraction will protect the lips of the wound from the saw. With the aid of the finger and an elevator, or with a lion-forceps, the head and neck of the bone are levered out of the acetabulum, this being often attended with some difficulty unless the capsule has been very freely opened. The ligamentum teres is probably distroyed; if not, it must be divided. The acetabulum is then examined, and, if merely roughened, left alone; if pitting or erosion be present, gouging must be resorted to. Any sequestra present must be removed. If the acetabulum is perforated, and pus present on its pelvic aspect, free exit must be provided by means of a gouge or small trephine, and a drainage-tube passed through.

FIG. 235.



Excision of the head of the right femur. Separation of the capsule and periosteum has been thoroughly performed. G, Glutæus maximus. M, Medius. C, The capsule opened. P, Pyramidalis. T, Great trochanter. The upper retractor raises the upper lip of the glutæus maximus, the medius, the minimus which is hidden, and the capsule. The lower retractor depresses the pyramidalis and the capsule. (Farabeuf.)

The inner surface of the capsule and all abscess cavities must now be thoroughly scraped and irrigated by means of a flushing spoon, as described below, until all granulation tissue and caseous *débris* have been removed. If sinuses are present, these must either be excised or carefully curetted according to their position and extent. Hæmorrhage is usually very slight, and with the exception of a few vessels, which may be caught with forceps, usually consists of a general oozing. This will usually be stopped by the hot irrigating fluid; if, however, it is troublesome, the cavity may be packed with gauze.

Drainage, either by means of iodoform gauze or a tube, will be necessary in nearly all cases. In a few, however, where no sinuses exist and there is no intra-pelvic abscess, and where all oozing has been arrested, a little sterilised iodoform may be rubbed in and the wound closed with sutures. The dressings must be carefully applied and firm pressure used to prevent oozing.

Site of Section of the Femur.—Having tried both, I think that the section through the great trochanter (*i.e.*, just below its upper margin) is preferable to one above it (*i.e.*, through the neck). The latter has the *advantages* of disturbing and damaging the attachments of muscles much less, and thus leads to more rapid healing and far greater mobility of the limb. These, however, are outweighed by the *disadvantage* which leaving such a large piece of bone as the trochanter entails—viz., that, after healing, this process gets drawn up against the scar and constantly frets it.* It is also said to check the escape of discharges, and to render the patient liable to persistence or recurrence of the disease. I am doubtful as to the last two, but the first is absolutely certain.

B. Mr. A. E. Barker,† has shown what excellent results **the anterior method** can give. In his Hunterian Lectures (*Brit. Med. Journ.*, 1888, vol. i. p. 1326) he advocated the use of this mode of excision in the early stage of hip disease. In later papers (*ibid.*, 1888, vol. ii. p. 1337, and 1890, vol. ii. p. 1009) he published some most successful cases thus treated in later stages, where other means had failed, and abscesses were threatening to burst. He advocates the anterior incision on the following grounds especially, (1) the interference with the muscles is practically *nil;* (2) the patient can thus be treated and his wound dressed much more conveniently—*e.g.*, with a Thomas's splint; (3) primary union can be secured if the following most essential points are strictly attended to; (*a*) the whole of the diseased structures must be removed; (*b*) perfect asepsis must be secured; (*c*) all oozing must be checked, and the wound kept dry by well-applied dressings; (*d*) absolute rest must be maintained during healing. With regard to the objection which has usually been considered to be fatal to the anterior incision, viz., the insufficient drainage which it gives—Mr. Barker replies that the incision, though anterior, is perfectly adequate for drainage, (1) because the discharges are, if the above-given precautions are duly followed, very small in quantity, "little more than odourless serum, which ought never to become truly purulent;" (2) "if all the tubercular tissue is removed, a clean-walled cavity is left, most of which is quite capable of healing by first intention, when its different surfaces are brought into close contact by firm pressure. And, in these cases, the head of the bone being removed and the acetabulum quite clean, the cut surface of the neck of the femur can be brought close up to the latter, so that although there is potentially a large space in the field of operation, there ought to be actually little or no cavity left, if pressure has been properly applied from the first."

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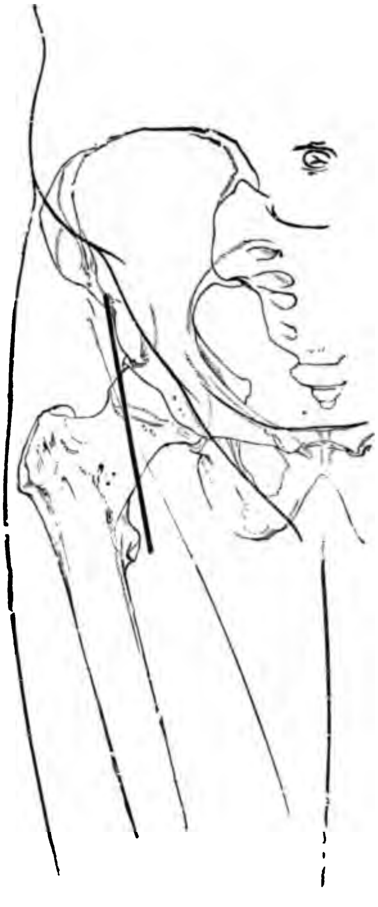
* About fourteen years ago I made use of this method in one case, sawing the bone through the neck and leaving the trochanter entire. A rapid recovery took place, and the boy quickly regained power over the limb. He has long been able to run and climb like other lads, and the movements of flexion, extension, abduction, and adduction are extraordinarily perfect. He has, however, been under my care on several occasions for superficial ulceration of the scar, which is fretted by the very prominent upper margin of the immediately subjacent trochanter.

† Mr. R. W. Parker (*Clin. Soc. Trans.*, vol. viii. p. 108) recommended this method as interfering less with the muscles and the blood-supply of the joint. Hüter was, I believe, really the first to use this incision, draining the joint by a counter-puncture at the back.

FIG. 236.



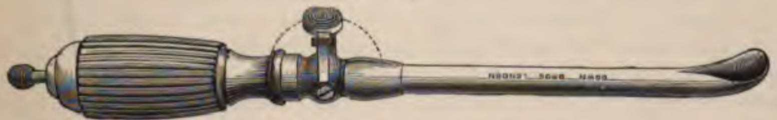
Anterior incision for excision of the hip. (Mac Cormac.)

Of the conditions which it is absolutely necessary to secure for the obtaining of primary union, and the success of the anterior incision, the first—that the whole of the diseased structures must be removed—is by far the most important. It is also, from my experience, the most difficult to secure. G. A. Wright (*Brit. Med. Journ.*, 1888, vol. ii. p. 1338), speaking at the discussion on one of Mr. Barker's papers, said that he had found the entire removal of the morbid tissues practically impossible either by the anterior incision which he used occasionally, or by the posterior. Only little foci of disease might be left, but they were apt to suppurate when some fall or accident gave them the opportunity. On this point we must wait for the light which further carefully-watched and reported cases alone can give us.

Operation.—The patient being on his back, with the limb extended, and the parts duly cleansed, the surgeon standing, in the case of either limb, on the right side, makes an incision three to four inches long, starting half an inch below the anterior superior spine, downwards and slightly inwards, between the tensor vaginæ and glutæi externally and the sartorius and rectus internally. The upper part of this incision should pass down to the capsule at once, the lower third should divide skin only. The interval between the above-named muscles is now thoroughly opened up and the wound retracted, so that the anterior surface of the capsule is exposed. This must now be opened, and with the limb flexed, the left index finger is passed into the joint. As the difficulty which is sometimes experienced in removing the head is usually due to an insufficient division of the capsule, this is now further incised with scissors, the left index finger being used as a guide. An aseptic finger now examines the condition of the joint. The wound being opened by retractors, a narrow-bladed saw is introduced into the upper part, in the direction of the wound, and with as little damage to the soft parts as possible, and the femur sawn through across the top of the great trochanter, or through the neck.

The advantages and disadvantages of the latter step have been already given at p. 599. In a case at all advanced there will always be a risk that a section as high up as this will expose diseased bone. The head of the femur is now extracted and the acetabulum treated by the means given at p. 598. Every atom of diseased structure must now be removed, especial care being taken to clear out any caseating abscesses communicating with the joint. All this should be done with as little violence as possible to the surrounding tissues, so that none of the tubercular *débris* be forced into the fresh-cut surfaces. The best instrument for removing the disease thoroughly is Mr. Barker's "flushing gouge" (Fig. 237). This has a cutting scoop-like edge, is perforated, and to its belt is attached tubing which communicates with an irrigating can. By this means boiled water (F. 105°) is kept flowing through the area of operation, carrying away the *débris* of disease whether from abscess cavities, the joint, or the surface of the acetabulum, if diseased, and with it all blood, while at the same time it arrests hæmorrhage. When every part of the field of operation has been gouged and scraped clear of all tubercular material, and the water runs clear, the cavity is dried out with carbolised sponges, one or two of which are left in it until all the sutures are *in situ*. These should dip deeply, and be placed close together. Just before they are tied, the sponges are removed, and with them the last trace of moisture. The wound is then filled up with iodoform emulsion, and the sutures are tied, as much of the emulsion as will come away being squeezed out at the last moment. Graduated even pressure is then applied by the dressing and bandages, so that the walls of the cavity are brought into apposition, and the remainder of the neck of the femur secured in the acetabulum. The patient is then placed in a double Thomas's splint. If sinuses are present, and the joint infected, the wound must not be closed, but drainage must be provided. The sinuses having been opened up and thoroughly curetted, must be plugged by means of strips of iodoform gauze passing down to the bottom.

FIG. 237.



Barker's flushing gouge. Down's Catalogue.)

With regard to the after-treatment I would urge that cases of hip excision should be got up as early as possible—*i.e.*, at the end of six or eight weeks. A double Thomas's splint, with foot-pieces, should be applied immediately after the operation, and worn for a period of from four to eight months. After this the child should get about on a patten and crutches, swinging the affected limb. He should not be allowed to use this for upwards of a year after the operation. If weight is borne on the limb earlier, the end of the femur is pushed upwards on to the dorsum ilii, and much shortening is the result. Mr. Barker has allowed some of his cases to get up and dispense with a splint at a much earlier period. I think the above-given dates better suited to these cases of excision of the hip, when we remember the risks to which they are exposed by their rough-and-tumble life when they leave the hospital.

Usual Causes of Failure after Excision of the Hip.

1. Persistent pelvic disease. 2. Chronic osteo-myelitis of sawn end of femur. 3. Suppuration and hectic. 4. Lardaceous disease. 5. Tubercular conditions elsewhere. General outbreak of tuberculosis. 6. Disease of the opposite femur.

Bruns, of Tübingen (*Beitr. z. klin. Chir.*, vol. xxii. part i., Tübingen, 1894), shows from carefully recorded cases that about two-thirds of the deaths after resection were due to a general tuberculosis or tuberculosis of other organs, one-third only being caused by suppuration and its sequelæ, septic infection, exhaustion, or amyloid disease.

CHAPTER II.

OPERATIVE INTERFERENCE IN DISLOCATION OF THE HIP.

HERE three varieties of cases have to be considered:—I. TRAUMATIC DISLOCATIONS. II. DISLOCATION FROM DISEASE (this is rather a partial dislocation, or a subluxation). III. CONGENITAL DISLOCATIONS.

I. TRAUMATIC DISLOCATION.—The great deformity, permanent crippling, and often great suffering resulting from old unreduced dislocations of the hip, abundantly justify resort to operation, nowadays, as long as it is understood that the operation may be a severe one, and the after-treatment one requiring great vigilance on the part of the surgeon.

In an excellent paper (*Ann. of Surg.*, Sept. 1894, p. 319) Dr. M. L. Harris, of Chicago, publishes an instructive case of his own and twenty-four others which he has collected. From these he draws the following conclusions: (1) Owing to the danger of fracturing the neck of the femur (*Arch. f. klin. Chir.*, 1885, Bd. xxxii. S. 440); of laceration of the great vessels of the thigh (*Ann. of Surg.*, June 1892, p. 425),—here, in an attempt to reduce by manipulation an obturator dislocation of thirteen weeks' duration in an adult, a fatal tear was produced at the junction of the superficial and deep femoral veins; or of shock and death (*Rev. d'Orthop.*, Sept. 1890), the application of great force to reduce old dislocations of the hip should be discontinued in favour of freely opening the joint and reducing the head of the bone, after the method used by Dr. Harris (*vide infra*). This is the treatment which gives the best results. (2) That subcutaneous operations in old dislocations are without benefit. (3) That as osteotomy below the great trochanter leaves the head in its abnormal position, and thus fails to relieve the pain which so frequently accompanies these old dislocations, and as it cannot improve the limited mobility which is always present, it is not to be considered in any way an operation of choice. (4) Resection is only to be thought of when reduction after free arthrotomy fails.

The following are the steps of the **operation** performed by Dr. Harris in his case of dorsal dislocation of nearly four months' standing, in which repeated and prolonged attempts at reduction had been made:

An incision about fourteen centimetres in length was made in front* of the great trochanter between the tensor vaginæ femoris and the glutæus medius, thus leading directly down to the acetabulum and anterior surface of the head and neck of the femur. As was expected, the acetabulum was found filled with a tough, adherent connective-tissue proliferation from the anterior portion of the capsular ligament, which, in falling over the cavity, completely closed it. On cutting through the capsular ligament, the head of the bone was found resting on the posterior and superior edge of the acetabulum in a shallow depression, the lining of which had a smooth cartilaginous feel. Immediately in front of the head and helping to fill the cotyloid cavity was a piece of bone, curved in shape, about three centimetres in length by one centimetre in depth and 0·5 centimetre in width, which had been detached from the posterior wall of the acetabulum. This may have been an obstacle to the early reduction of the case. The head of the bone was still covered with smooth cartilage, while the neck had acquired new firm adhesion to all the surrounding parts, thus producing a new capsular ligament.

A restoration of the ligamentum teres could not be demonstrated, but a small portion of it was present in the depression in the head when this was turned out of its new joint. The adhesions to the neck were divided, and all the muscular attachments to the great trochanter and shaft as far down as the lesser trochanter were separated sub-periosteally from the bone, thus liberating the entire upper end of the femur. Attention was then directed to the acetabulum, which, by means of the gouge and sharp spoon, was freed of capsular ligament and the new connective-tissue formation. The cartilage lining the bottom of the cavity was found to be still smooth. The head of the bone, however, could not be made to enter the acetabulum, which seemed too small. The cavity was consequently enlarged somewhat posteriorly with the gouge and mallet, after which, by considerable exertion and manipulation, the head was finally returned to its place, and the leg assumed its normal position. The wound was partly stitched up, and the rest packed with iodoform gauze. The limb was placed in the extended position, plaster of Paris put on, and extension applied. The operation was a very severe one, occupying fully two hours. The patient suffered considerably from shock, although the loss of blood was not great. Reaction came on promptly, and the progress of the case was favourable from the start. There was considerable serous drainage from the wound during the first few days, necessitating rather frequent renewals of the dressings. In three weeks the wound was closed, but in another week a small collection of sero-pus required evacuation by a counter-puncture. The extension was continued three weeks. Six weeks from the time of the operation the patient was allowed up on crutches. In three months he could walk with a cane without pain in the hip. There was active motion in all directions—flexion, abduction, adduction, and rotation, which, though limited, were daily increasing.

II. DISLOCATION FROM DISEASE.—This has been referred to at p. 593.

III. CONGENITAL DISLOCATIONS.—Operative interference in this condition should not be undertaken unless the bloodless method of reposition by manipulation† has been given a fair trial, and has failed. Even then the advisability of operative interference here is still much disputed. When we consider the condition of the parts affected, especially the shallow, ill-developed acetabulum, and the altered flattened head, we can easily understand the difficulty which has been met with in getting the head into, and retaining it in, a satisfactory position. Certainly the results which have been attained either in England or abroad cannot be considered to be satisfactory. Moreover, it is equally certain that whatever benefit results is to be attained only at considerable risk (*vide infra*), and that the amount claimed is sometimes open to dispute.[*] Finally, the fact that Hoffa has practically abandoned his own operation speaks for itself.

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* In a case of traumatic dorsal dislocation in a boy, aged 7, reduced after five months by the open method, and brought by Dr. Spencer before the Clinical Society, Feb. 8, 1895, a long anterior incision showed the acetabulum to be filled with dense fibrous tissue. It is stated that the acetabulum could not have been reached by a posterior incision without resecting the head of the bone.

† The best method to employ is the Paci-Lorenz, a detailed account of which will be found in the *Medical Annual*, 1898.

As long as the technique of these operations requires so much interference with the parts, as long as the risks of sepsis, shock, &c., are so great, no operative steps should be undertaken unless the risks and the results have been fully put before the friends.

Choice of Operations.—If an operation has been decided upon, Hoffa's[†] operation of division of the retaining shortened structures and replacement of the head of the bone in the acetabulum (which should be deepened) may be performed, or a new acetabulum may be made in children under 10. In older patients, *e.g.*, 10 to 16, if the deformity is really severe and disabling, Kirmisson's[‡] subtrochanteric osteotomy with subcutaneous division of the adductors may be tried.

Operation.—The following account of Hoffa's operation is taken from an article by Dr. T. H. Myers (*Ann. of Surg.*, Aug. 1894,[§] p. 144):

Opening the joint by Langenbeck's incision, division of the capsule at its insertion in the neck of the femur, and sub-periosteal freeing of the great trochanter from all the muscles attached to it, are the first steps. In patients under five years old it is then almost always possible by flexion of the thigh and direct pressure upon the head to bring this into the old acetabulum. The hip and knee now are often seen to be flexed. Hoffa overcomes this in young children by holding the head firmly in the acetabulum while an assistant gradually extends the leg on the thigh, so stretching the biceps, semi-membranosus, and semi-tendinosus. This is accomplished in three to five minutes. In older children, six years and upwards, it is generally better to divide these muscles, and this is done before opening the joint. Hoffa has adopted Lorenz's recommendation of dividing them at the tuber ischii.

The limb is now abducted, and the adductors subcutaneously divided, then hyper-extended and the soft parts attached to the anterior superior spine of the ilium, and the fascia lata, divided by the open method so as to control better the hæmorrhage. These wounds are now dressed, and the joint is then opened as described above. The head must be freed so completely that it can readily be brought out of the wound. Hoffa has never seen any necrosis of the head follow this free division. The ligamentum teres, if present, must be extirpated, and the insertion of the capsule into the neck freely divided. A sharp Volkmann's spoon, bayonet-shaped, is now guided by the index-finger to the acetabulum, and the fatty tissue and cartilage and a good deal of spongy tissue are scraped out, taking care to preserve the edges of the acetabulum. The cavity must be made not only deep but broad. This is best accomplished by cutting away posteriorly.

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[*] See a case brought before the Clinical Society and the remarks made at the discussion (*Brit. Med. Journ.*, vol. i. 1895, p. 365).

[†] Hoffa's operation was first described, April, 1890, *Verhand. Deutsch. Gesellschaft f. Chir.*, p. 944. He is stated (*Ann. of Surg.*, Aug. 1894, p. 145) to have operated *seventy-five times*, and is clearly an enthusiast. He lays great stress on the age. The younger the child, the better the result. This is readily intelligible, but the increased risks after operation (*vide infra*) at this early age must not be forgotten.

[‡] *Revue d'Orthopédie*, No. 2, 1894.

[§] Hoffa makes use of a posterior incision, as he believes that the structures which chiefly require division are the muscles attached to the great trochanter and tuber ischii. Lorenz and others, who believe that it is the Y ligament which is the chief obstacle to reduction, recommend the anterior incision. When this is made use of, another running transversely outwards may be needed to give access to the acetabulum.

The head is now reduced, and goes into its place with a snap. The superfluous part of the capsule is then extirpated, the wound partly sutured, and the rest packed with iodoform gauze. If there is any rotation forward of the neck and head, the limb must be put up in moderate inversion, otherwise the head will slip out of the new acetabulum. After a few weeks it may be brought to the normal position. Lorenz, in such a case, also advises putting the limb up in inversion, and a subsequent sub-trochanteric osteotomy to correct this.

Careful passive movement is begun in three or four weeks, and after five weeks the child is allowed to stand and walk in an apparatus which allows of motion of the hip, but does not allow the head to escape from the acetabulum.

It remains to allude to **the results** of operative interference both **good and bad,** though but little has been heard of the latter. Redard (*Traité de Chir. Orthopéd.*, Paris, 1892, p. 534), Dr. T. H. Myers, and Dr. V. P. Gibney, of New York (*Ann. of Surg.*, Aug. and Dec. 1894) accept the following conclusions: "(1) The number of perfect cases is very small. (2) The number of cases improved is large. (3) The results in double dislocation are not so favourable as in single. (4) The lordosis is generally corrected. (5) The limp persists to some degree, though a high shoe will improve this greatly. A paper by Dr. E. H. Bradford, of Boston, is especially instructive, as it contains an account of a specimen taken from a child who died of diphtheria and septicæmia a month after Hoffa's operation had been performed. He considers that while "the method of operative reduction offers the best prospect of a cure, it involves risk and is not certain in its result."

Finally as to the risks. These are certainly serious. The following have been published:—1. Shock. 2. Hæmorrhage. 3 and 4. In young children the effects of the anæsthetic and of iodoform intoxication must also be remembered together with the above. 5. Peritonitis. This has followed in one case, after perforation of the bone in fashioning the acetabulum.* 6. Septic conditions. 7. Prolonged suppuration. Dr. Gibney (*loc. supra cit.*), with candour that does him great credit, says that profuse suppuration followed in the majority of his nine cases (seven of these were cases of congenital dislocation). This continued for many weeks and months, during which time the wound should have been healed and movements begun. 8. Recurrence of the faulty position.

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* A gouge and mallet were being used (*Revue d' Orthopédie*, Jan. 1893).

CHAPTER III.

OPERATIONS ON THE THIGH.

LIGATURE OF THE COMMON FEMORAL.—LIGATURE OF THE SUPERFICIAL FEMORAL IN SCARPA'S TRIANGLE.—LIGATURE OF THE SUPERFICIAL FEMORAL IN HUNTER'S CANAL.—PUNCTURED AND STAB WOUND IN MID-THIGH.—AMPUTATION THROUGH THE THIGH.—AMPUTATION IMMEDIATELY ABOVE THE KNEE-JOINT.—REMOVAL OF EXOSTOSIS FROM NEAR THE ADDUCTOR TUBERCLE.—UNUNITED FRACTURE OF THE FEMUR.

LIGATURE OF THE COMMON FEMORAL.

THOUGH this operation is not regarded with much favour, especially for aneurysm, it will be described here, as the question of tying it arises from time to time, and as it should always be performed, for the sake of practice, on the dead body.

Indications.

1. Wounds.—These are rare, here, compared with those affecting the vessels lower down. The wound must always be explored and the bleeding-point sought, for two reasons—(*a*) Ligature of the external iliac will usually fail to arrest bleeding from the common femoral. (*b*) The source of the bleeding may easily be mistaken here; thus, Mr. Liston,* in a case of pistol-shot wound of the groin, tied the external iliac for what was proved, post mortem, to be a wound of "one of the superficial branches of the common femoral, about half an inch below Poupart's ligament."

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* *Med.-Chir. Trans.*, vol. xxix. p. 107. The flow of the blood here is said to have been "most impetuous and profuse." In Mr. Liston's words: "The division of even a small branch close to the principal vessel, it is well known, pours out blood furiously, as much so, in fact, as if an opening in the coats or the artery itself were, so to say, punched out. corresponding in size to the area of the branch."

After ligature for gunshot injuries, whether for direct or for consecutive bleeding unattended by primary injury to the vessel, the mortality in the American War* seems to have been high—over 70 per cent.

The very important subject of **ligature of the femoral artery or vein, or both, in cases of wounds**, will be referred to here, though briefly. Such cases will arise most frequently in removal of growths—*e.g.*, epitheliomata, lymphomata, sarcomata—less often in cases of stabs. Much interesting information on these subjects will be found in papers by M. Kirmisson,† and Dr. L. Pilcher.‡

2. Removal of Growths from Scarpa's Triangle and Injury to Femoral Vessels.—M. Kirmisson has drawn attention to the following points: In the course of the deeper dissection the pulsation of the femoral artery should be frequently felt for with the finger. As this vessel may have been displaced, it is not enough to trust to anatomical knowledge alone. After separating the structures on either side of the growth, this should be left adherent where it is in connection with the sheath, and especial care devoted to this spot. Where the adhesions are very firm, and where a large growth surrounds the sheath, it is useful to divide the growth and to remove large parts of it, only preserving that part in intimate connection with the vessels, this being finally separated most carefully. In the case of growths in intimate connection with the sheath the vein is particularly in danger, because (*a*) the vein-walls are much more quickly invaded than the arterial, and (*b*) the vein is in closer connection with the glands. Two conditions are likely to be met with by the surgeon: 1. Denudation of the vessels. Here the adhesions are sufficiently loose to be separated, and the sheath is either left intact or opened. Every effort must be taken to keep the wound here aseptic. 2. Resection and ligature of one or other of the femoral vessels. If the vein alone has been injured in an operation or by a stab, it should be secured if possible by a laterally applied ligature, by the application of Spencer Wells's forceps left *in situ* for two or three days,§ or by suture of the walls. All of these formerly hazardous procedures have been rendered much safer by the precautions of aseptic surgery. Maubrac (*Arch. Gén. de Méd.*, 1889) strongly advocates lateral suture, especially when the lesion is small. Kammerer (*New York Med. Journ.*, 1890, vol. i. p. 511) points out that suture of the wall has undoubted advantages, and that it has been used successfully in the case of the femoral vein by Schede (*Arch. f. klin. Chir.*, Bd. xxviii. p. 671), and Lange (*New York Med. Jour.*, vol. xliv. p. 720). If these steps are impossible, or fail, the femoral vein must be ligatured.

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* Otis (*Medical and Surgical History of the War of the Rebellion*, part iii. pp. 16, 43, 49).

† *Rev. de Chir.*, May 10, 1886. I am indebted for my knowledge of this paper to an abstract by Mr. T. Jones, of Manchester (*Med. Chron.*, September 1886, p. 514).

‡ *Ann. of Surg.*, February 1886.

§ A case in which I thus treated a wound of the internal jugular has been recorded in Vol. I. at p. 557. Pilcher mentions a case of Küster's, in which a wound in the vein was secured with hæmostatic forceps; the removal of these after only twenty-four hours was followed by renewed bleeding, ligature of the femoral artery, and fatal gangrene.

Dr. Pilcher, quoting from a paper of Braun's,* shows that of eighteen cases in which ligature of the femoral vein alone was practised at the level of Poupart's ligament, thirteen occurred as the result of wounds inflicted during the removal of growths. In none of these thirteen cases did gangrene ensue. Dr. Pilcher points out that this is due to the gradual enlargement of the collateral venous circulation which takes place during the increase of the growth. This constitutes a most important difference between wounds of the vein during operation and by a stab. Thus, in five cases in which, as the result of acute injuries, the femoral vein was tied high up, recovery without disturbance took place in only one. In two, death took place from septicæmia and pyæmia; in the remaining two, gangrene rapidly supervened. In the case of stab-wounds of the common femoral vessels the complication of sepsis has to be remembered.

Thus, Mr. Gould (*Med. Soc. Proc.*, vol. x. p. 177) published a case of great interest in which the common femoral vein was wounded ("the whole anterior segment of the vessel" being severed) with a cat's-meat knife. A ligature tied round the vein above and below the wound not arresting the bleeding, the internal saphena which entered the femoral just opposite the wound was tied also. Blood still welled up from the wounded vessel, and further search showed that another vein entered the femoral trunk just opposite the wound in the trunk between the two ligatures. This vein was tied and then all hæmorrhage was found to be arrested. Though the wound was very thoroughly irrigated with solution of hydr. perch. (1-2000), all the infective material introduced by the knife could not be removed. Septic phlebitis followed, with inflammation of the coats of the artery and hæmorrhage on the ninth day necessitating ligature of the superficial and deep femoral arteries. Meanwhile the septic thrombus had been spreading up the iliac vein until all the chief channels for the return of venous blood were blocked. This brought about moist gangrene, the patient dying on the eleventh day with blood-poisoning, accelerated by the loss of arterial blood.

The question has been raised whether, when ligature of the common femoral vein has been found needful, the common femoral artery should not be tied also, in order to diminish the risk of gangrene. Dr. Pilcher, while quoting the cases of Roux, Linhart, and Langenbeck, in which this step was successful, shows that the practice of ligature of the common femoral artery as a prophylactic step after wound of the common femoral vein high up, whether in the removal of tumours or injuries—*e.g.*, stabs—is to be discouraged.†

Dr. Pilcher suggests (*loc. supra cit.*, p. 119) that where the femoral vein has been suddenly and completely occluded high up it will be wiser to tie not the common but the superficial femoral artery, as likely to materially diminish the current to the limb, while the amount provided will be quite sufficient for its nutrition.

In cases where both vein and artery are wounded these must be secured *in situ*. The risk of gangrene is now enormously increased, though the risk will vary somewhat according as the simultaneous ligature is made above or below the deep femoral.

A few other points bearing upon the removal of tumours here may be alluded to. The internal saphena vein should be carefully preserved intact, and where it is really needful to divide it this should be done as far from the main femoral trunk as possible, otherwise most troublesome œdema may subsequently develop.*

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* *Arch. f. klin. Chir.*, Bd. xxviii. Heft. 3, S. 610.

† In support of this, Dr. Pilcher writes: "To diminish, to an extreme degree, the arterial supply to a part whose nutrition is already seriously compromised by general venous stasis, would certainly tend to precipitate and aggravate the threatened necrosis."

In operating close to Poupart's ligament, and especially on the inner side, the presence of the peritonæum,† and the possible existence of a femoral hernia, must be remembered.

3. Ulceration into the Artery by Growths.—From the frequency of growths here this indication will occasionally arise. I have met with one case. A man was admitted under my care who had been operated on elsewhere for the removal of sarcomatous glands in the groin. The application of zinc chloride paste had led to detachment of sloughs and exposure of the common femoral, which gave way, leading to profuse hæmorrhage. I tied the common femoral immediately above the bleeding-point; this was slowly followed by typical dry gangrene, necessitating amputation through the lower third of the thigh.

4. Ulceration into Femoral Vessels in Inguinal Bubo.—Mr. Shield has drawn attention to this most dangerous condition (*Med. Soc. Proc.*, vol. x. p 261). Though in his case ulceration occurred in the *superficial* femoral vessels, I have alluded to it here, in association with the previous two headings. Owing to hæmorrhage from sloughing sinuses in Scarpa's triangle, Mr. Shield was obliged to tie both artery and vein, using two ligatures in each case. There was no return of hæmorrhage, and gangrene did not occur, but the patient sank exhausted on the eleventh day with a large pyæmic abscess in the opposite hip-joint. Mr. Shield points out that in these most dangerous cases of spreading sloughing bubo, preventive treatment—use of the sharp-spoon, chloride of zinc paste, continuous warm baths, &c.—is urgently indicated. When once bleeding has occurred and recurred, as pressure,‡ owing to the condition of the soft parts, is likely to fail, a free incision and ligature of the vessels above and below the point of ulceration is the wisest course.

5. Aneurysm.—There has been much difference of opinion as to whether it is wiser, when dealing with an aneurysm on the superficial femoral high up, to tie the common femoral or the external iliac. English surgeons have rejected ligature of the common femoral for these reasons—(1) The risk of gangrene, as the ligature is placed above both the great nutrient arteries of the limb. (2) The probability of firm clotting taking place after the ligature is rendered doubtful, owing to the number of small vessels given off here—viz., the superficial epigastric, and circumflex iliac, the superior and inferior external pudic, and very commonly one of the circumflex arteries, and also by the

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* Dr. Pilcher (*loc. infra cit.*, p. 214) mentions a case where, after ligature of the saphena vein close to the common femoral, the tendency to œdema was so great that the patient, unfitted for work, begged for removal of the limb.

† M. Kirmisson gives a case in which the peritonæum was wounded and sutured, the patient recovering.

‡ At the debate on Mr. Shield's paper, Mr. Cripps—a high authority—supported pressure in these cases. It should be applied methodically according to Mr. Cripps's plan (*vide infra*, p. 617), and, to secure asepsis in these most persistently foul cases, it would be well to try the application of that powerful styptic and disinfectant, turpentine.

proximity of the profunda. (3) The uncertainty of the origin of the profunda, and thus of the length of the common femoral. (4) I would add to the above that ligature of the common femoral for aneurysm approximates the treatment to that of Anel rather than to that of Hunter. Sir J. E. Erichsen[*] went so far as to say, "It may be laid down as a rule in surgery, that in all those cases of aneurysm which are situated above the middle of the thigh, in which compression has failed and sufficient space does not intervene between the origin of the deep femoral and the upper part of the sac for the application of a ligature to the superficial femoral, the external iliac should be tied."

Mr. Holmes,[†] while adducing facts to show that the operation on the common femoral is not in itself by any means so fatal as has been represented, and that no just cause whatever has been shown for banishing it from surgical practice, allows that he should be in favour of ligature of the external iliac for femoral aneurysm high up, under ordinary circumstances, reserving ligature of the common femoral for cases where the belly is extremely fat.

The opposite opinion has been held by some of the Irish surgeons—viz., the two Porters, Mr. Smyly, Mr. Butcher, and Dr. Macnamara. The last-mentioned surgeon has published[‡] eight cases, of which six were successful, two dying of hæmorrhage.

It is probable, however, that, for the reasons given above, ligature of the external iliac will be preferred, especially as, nowadays, antiseptic precautions and improved ligatures will have rendered this operation increasingly safe.

6. As a Preparatory Step to Amputation at the Hip-joint.—The need of this has been largely done away with by the Furneaux Jordan method. Where this is not available, one of the other means given at p. 579, will, I think, be found preferable.

LINE AND GUIDE.—From a point midway between the anterior superior spine of the ilium and symphysis pubis to the adductor tubercle, and the inner margin of the internal condyle.

Another line is sometimes taken from the centre of Poupart's ligament (or a point midway between the two spines) to the inner margin of the patella or the front of the internal condyle, but that above given is the more correct.

RELATIONS: IN FRONT.
Skin ; fasciæ ; lymphatic glands.
Crural branch of genito-crural. Sheath.

OUTSIDE.		INSIDE.
Anterior crural.	Common femoral.	Septum of sheath. Femoral vein.

BEHIND.
Sheath.
Psoas.

It is important to note that the common femoral is usually only an inch and a half long, and that from it come off not only the superficial epigastric, circumflex iliac, and superior and inferior external pudic, but occasionally one of the circumflex arteries as well.

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[*] *Surgery*, vol. ii. p. 244.

[†] Hunt. Lect., *Lancet*, 1874, vol. ii. p. 300.

[‡] *Brit. Med. Journ.*, October, 5, 1867. Mr. G. H. Porter (*Dub. Journ. Med. Sci.*, vol. xxx. N.S. 1860, p. 302) reports three cases, and alludes to two under his father's care. All were successful, though secondary hæmorrhage occurred in two.

Collateral Circulation.

ABOVE.		BELOW.
Glutæal and sciatic,	with	Superior perforating and circumflex arteries.
Superficial circumflex iliac,	with	Ascending branch of external circumflex.
Obturator,	with	Internal circumflex.
Comes nervi ischiadici,	with	Perforating of profunda and articular of popliteal.

Operation.—The groin having been shaved and cleansed, the hip and knee semiflexed, and the limb abducted and rotated somewhat outwards, an incision about two and a half inches long is made in the line of the artery, commencing just above Poupart's ligament. The skin and superficial fascia having been divided, and any overlying glands displaced or removed, any veins which may be met with descending to join the internal saphena are either drawn aside or tied between double ligatures. The fascia lata having been opened just below Poupart's ligament, the artery or its pulsation is felt for, the vessel exposed here, and the needle passed from within outwards, care being taken to avoid the crural branch of the genito-crural nerve, which lies superficial to the artery. The neighbourhood of any branch is, if possible, avoided. The wound is then most carefully dried out and closed.

By another method the artery is found by an incision parallel with the centre of Poupart's ligament and about half an inch below it. This is recommended by Mr. Porter and Dr. Macnamara (*loc. supra cit.*). Of the two, the first, in the line of the vessel, is to be preferred.

LIGATURE OF THE SUPERFICIAL FEMORAL IN SCARPA'S TRIANGLE (Figs. 239 and 240).

Indications.

1. Certain Cases of Aneurysm of the Popliteal Artery or the Femoral low down.—Thus the ligature will probably be indicated—(*a*) where a popliteal aneurysm is rapidly growing, especially when (*b*) it is on the anterior aspect of the artery instead of behind or at one side of it, as in the former case the knee-joint may become involved after very obscure symptoms; (*c*) when the aneurysm is fusiform rather than saccular; (*d*) when it has very thin walls; (*e*) when it threatens to burst, or when this has already happened, unless other symptoms—*e.g.*, gangrene—call for amputation; (*f*) if visceral disease—cardiac, renal, hepatic—or an atheromatous condition of the vessels is present, the surgeon must weigh carefully the question of operative interference: I should prefer in most cases a trial of the ligature as likely, with the aid of antiseptic precautions, a modern ligature and primary union, to entail less taxing of the patient's powers; (*g*) where a trial of pressure has failed, or is certain to fail from the irritability of the patient.

2. Wounds.—Nothing need be added here to what is said on the subject at pp. 607 and 616.

3. For Hæmorrhage low down—*e.g.*, after amputation in the middle of the thigh, when other means fail and the wound is nearly united (p. 618). Two other instances are given by Mr. Bryant (*Surgery*, vol. ii. p. 417). One was "a case of Mr. Bransby Cooper's in which a compound fracture of the leg was complicated with a laceration of the femoral artery. The artery was secured at the seat of injury, and repair went on well in all respects. Mr. Bransby Cooper has also recorded in his *Surgical Essays* a case of fracture of the femur in which the femoral artery was ligatured for a ruptured popliteal artery, and in which recovery took place in six weeks." Each of such cases must be considered on its own merits, but the above shows what ligature of the femoral artery will do in appropriate cases.

4. For Elephantiasis.—Cases in which the superficial femoral has been tied will be found in the *Lancet* for 1879, vol. i. p. 44; and Ranking's *Abstract* for 1860, vol. ii. p. 193. The subject of ligature of the main artery of a limb for this affection has been considered at p. 3.

5. Acute Inflammation of the Knee-joint.—Mr. Maunder brought a case before the Clinical Society (*Trans.*, vol. ii. p. 37), in which, at his suggestion, Mr. Little had tied the femoral artery for acute inflammation of the knee-joint, ten days after a lacerated wound. The pain and other acute symptoms were at once relieved, and the patient made a good recovery. The antiseptic treatment of wounds of joints, aided by free incisions, will, nowadays, do away with the need of the above treatment.

LINE.—That above given, p. 611.

GUIDE.—The above line and the inner border of the sartorius at the apex of the triangle.

RELATIONS.—

IN FRONT.

Skin; superficial fascia; glands; crural branch of genito-crural nerve; middle cutaneous and branch of internal cutaneous; fascia lata; sartorius.

OUTSIDE.	INSIDE.
Femoral vein (below). Anterior crural nerve, and some of its branches—viz., the nerve to the vastus internus, and long saphenous nerve.	Femoral vein (above).

BEHIND.

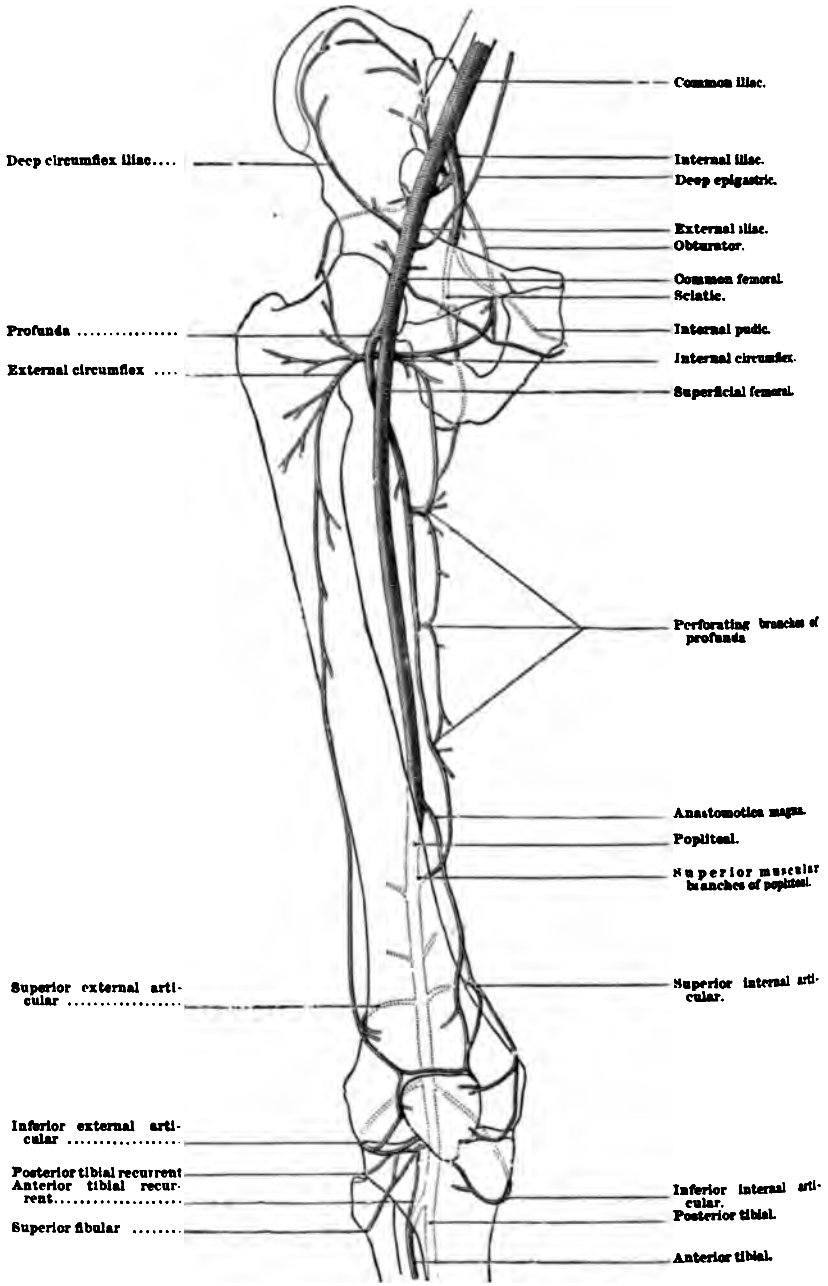
Psoas; pectineus; adductor longus; femoral vein (below); profunda artery and vein; nerves to pectineus.

Collateral Circulation.

ABOVE.		BELOW.
Perforating of profunda,	with	Lower muscular and anastomotic of femoral, articular of popliteal, and anterior tibial recurrent.
External circumflex of profunda,	with	Ditto ditto.
Comes nervi ischiadici,	with	Perforating of profunda and articular of popliteal.

Operation.—(Figs. 239, 240).—The parts having been shaved and cleansed, the knee and hip slightly flexed, the thigh abducted and somewhat everted, and the leg resting on a pillow, the surgeon, seated or

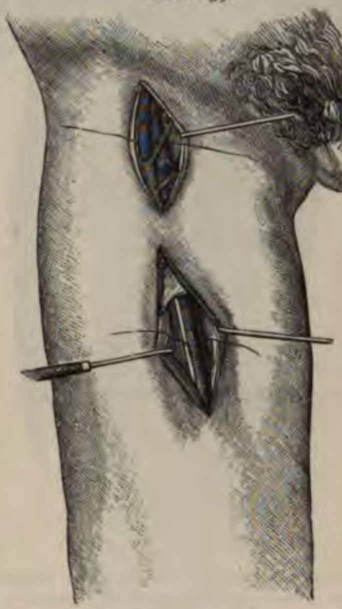
FIG. 238.



Anastomotic circulation of the iliac and femoral arteries. (Mac Cormac.)

standing to the right of the affected limb, makes an incision three inches long in the line of the artery (p. 611). This should begin about two inches and a half below Poupart's ligament, and run down to, and somewhat below, the apex of Scarpa's triangle, which lies usually four to five inches below Poupart's ligament. The skin and superficial fascia having been divided, any small vessels are secured, and branches of the saphena vein drawn aside with a strabismus hook or secured with double ligatures. The deep fascia is now slit up for the whole length of the wound, and the inner margin of the sartorius, which crosses the lower part of the incision, identified. This is then drawn outwards, and so held with a blunt hook or retractor, while the artery or its pulsation is felt for. The wound being now well opened out with retractors and carefully wiped out, the sheath is opened to the outer side, care being taken to avoid the nerves in contact with it —viz., the long saphenous, and the nerve to the vastus internus. The artery having been cleaned, thoroughly but most carefully, on either side and behind, the needle is passed from within outwards, being kept very close to the vessel so as to avoid the vein which lies behind and internally.* The artery having been tied, the ligature is cut short, drainage provided by horsehair or a small tube, according to the amount of disturbance of the parts, &c. and the wound closed. The precautions given at p. 6 for the prevention of gangrene must be taken.

FIG. 239.



Ligature of the common femoral, and the superficial femoral at the apex of Scarpa's triangle. The ligature in each case has been passed from within outwards. (Sédillot.)

Difficulties and Mistakes.

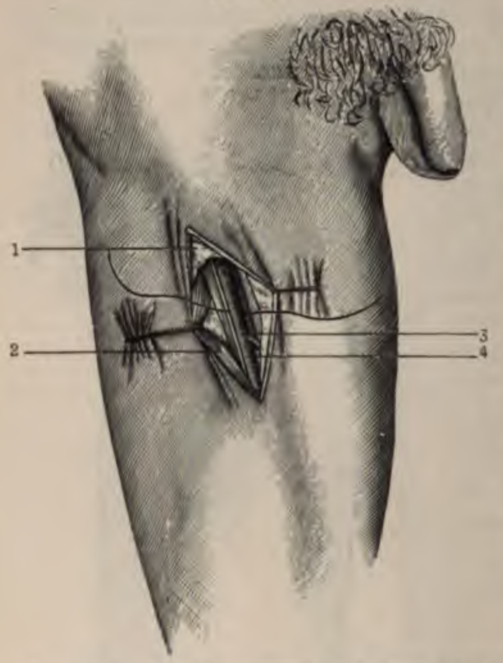
1. Wounding the Saphena Vein.—This may occur if the incision is made too internal. It is always to be avoided if possible, owing to the troublesome œdema which may follow. 2. A very broad Sartorius. 3. Injury to the Femoral Vein.—This may easily take place if force is used in pushing the needle round an imperfectly cleaned artery, or if

---

* The vein is so frequently damaged here, especially on the dead subject, that a few precautions may be given as to the best way of avoiding it. First, the sheath must be identified exactly, and sufficiently opened at its outer part. It will be found of much help in cleaning the vessel if one edge of the cut sheath is held by an assistant, while the surgeon has hold of the other; the opening in the sheath is thus made sure of and retained. There must be no needless disturbance, or lifting up of the vessel upon the needle, which, with the director, must be used with the utmost carefulness. As soon as the eye (and this should be at the very end of the needle) is seen to have passed round the vessel the ligature should be at once seized and the needle withdrawn.

the needle is not kept close to the vessel. If the accident occur, the surgeon must not persist in his attempt to tie the artery at this spot, a course which will only end in his inflicting more injury in the vein, but finger-pressure being made in the lower angle of the wound, the artery is tied either above or below the spot where the vein has been injured. As soon as the artery is secured, no further hæmorrhage will take place, but pressure may be kept up by means of sterilised dressings over the wound for a day or two.* The patient will do well to wear a Martin's bandage or an elastic stocking for some time after getting up. 4. Including one of the nerves. 5. A matted condition of the parts due to a previous trial of compression.

FIG. 240.



Dissection of parts concerned in ligature of the femoral artery at the apex of Scarpa's triangle. 1. Fasciæ. 2. Sartorius. 3 and 4. Superficial femoral artery and vein.

Abnormalities of the Femoral Artery.

1. A double superficial femoral, the two trunks uniting below to form the popliteal. More than one case of this kind is recorded. The persistence of pulsation in the aneurysm after the first ligature would lead to a suspicion of this condition. 2. The vessel may run down at the back of the limb.

LIGATURE OF THE FEMORAL ARTERY IN HUNTER'S CANAL (Fig. 242).—TREATMENT OF A STAB IN MID-THIGH (Fig. 241).

Indications for Ligature of the Femoral Artery in Hunter's Canal.

1. Wounds.—These may be, (*a*) incised; (*b*) punctured.

(*a*) Here, if immediate death from hæmorrhage has been prevented, the wounded vessel must be secured. The artery above being compressed by an Esmarch's bandage or the hands of an assistant, the wound is enlarged, clots are sponged away, and the artery tied above and below the wound in it (Fig. 241). If the vein is injured too severely for a laterally applied ligature (p. 608), and requires ligature in the ordinary way, the patient or the friends must be prepared for the imminent need of amputation.

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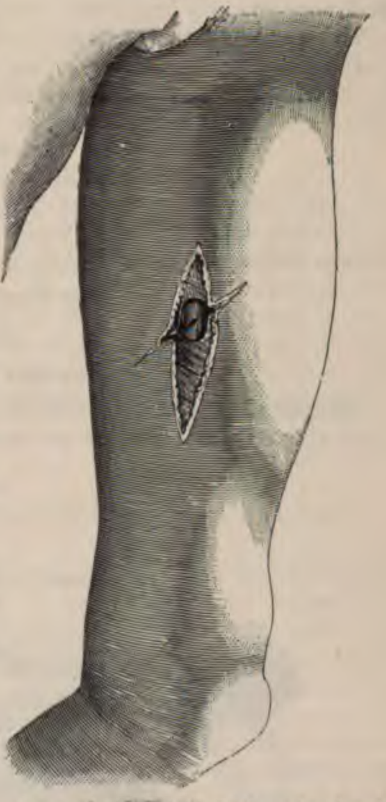
* If venous hæmorrhage persist, the opening in the vessel should be secured with a chromic-gut ligature, or a pair of Spencer Wells's forceps left *in situ* (p. 608).

(*b*) If a punctured wound lies in the line of the artery (p. 613), and if much blood has been lost, the main trunk is probably injured, and the question will arise, if the bleeding has ceased, whether to cut down upon the artery or to trust to pressure. Mr. Cripps (*Dict. of Surg.*, vol. i. p. 525) advises that, if the wound be in the upper part of the thigh, "the surgeon may enlarge the wound with a good prospect of finding the wounded vessel without an extensive or prolonged operation. If the wound be in the lower half of the thigh, owing to the greater depth of the artery and the possibility of its being the popliteal which is wounded, the search is rendered far more severe and hazardous, and it should not be taken until a thorough trial of pressure has proved ineffectual."

The following mode of applying pressure is taken from Mr. Cripps (*loc. supra cit.*).* I would also refer my readers to the account of punctured wound of the palm given at p. 26, Vol. I., of this work.

FIG. 241.



Incised wound of the thigh explored and found to involve the femoral artery. An Esmarch's bandage should have been shown *in situ* above.

The main vessel having been controlled above, the foot and leg should be carefully strapped from the toes to the knee, and a bandage then carried from the toes up to the wound, and then, avoiding this, up to the groin, where it is secured, spica-fashion, over a pad on the main artery. The limb is then laid on a long back splint with a foot-piece, and secured to this in an elevated position. The wound having been cleansed and dusted with iodoform, a graduated compress is then fastened over it. Two rectal bougies are then applied in the course of the artery, above and below the wound, outside the bandage which surrounds the limb, so as to keep these segments of vessel empty. Two well-padded lateral splints are then secured with straps and buckles to the thigh. Morphia must be given as freely as is judicious.*

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* Mr. Cripps's account will be found under the heading of the treatment of secondary hæmorrhage from the femoral. He draws attention to the instructiveness of the literature of this subject, as it proves not only that many cases have been successfully treated by pressure from the first, but that both life and limb have been saved by pressure after the surgeon has failed to find the artery in the wound, or after the iliac has been tied in vain.

2. Hæmorrhage from a Stump after Amputation in the Lower Third of Thigh or Knee.—If clearing away the clots and disinfecting the stump, followed by well-adjusted pressure, and, this failing, trying to find the bleeding point in the flaps, do not suffice, the artery must be tied above.†

LINE AND GUIDE (p, 611).

RELATIONS:

IN FRONT.

Saphena vein.
Skin; fasciæ; sartorius; aponeurosis between vastus internus and adductors.

OUTSIDE.	INSIDE.
Vastus internus; vein (slightly).	Adductor longus and magnus.

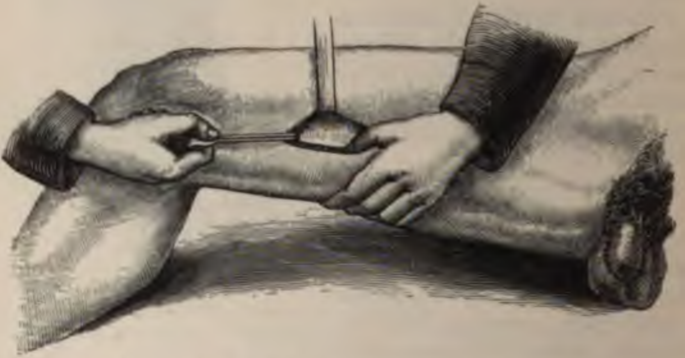
Femoral artery in Hunter's canal.

BEHIND.

Femoral vein (especially above).

Operation (Fig. 242).—The knee and hip having been flexed, and the limb abducted and rotated outwards, the surgeon, seated comfortably on

FIG. 242.



Ligature of the femoral artery in Hunter's canal. The surgeon standing outside finds the furrow between the adductors and the quadriceps, and then makes an incision in the line given at p. 611. The lower lip of the wound having been depressed with the left thumb, the deep fascia is divided on a director. (Farabeuf).

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* Mr. Cripps advises that the limb should be slightly raised on a pillow, and partly bent at the knee and thigh. The toes should be left exposed that their condition may be watched.

† I would again refer my readers to Mr. Cripps's article (*loc. supra cit.*, p. 526). He points out that a decision between opening the flaps or ligaturing the main vessel high up must depend on the amount of union, and that if the flaps must be opened and the vessel sought for before there is much firm union, as in the first fortnight, a director should be used rather than a knife, and that if the vessel is found, its soft condition will require very gentle tying.

the inner side of the limb, makes an incision three inches and a half long in the line of the artery in the middle third of the thigh.* The skin, superficial and deep fasciæ, having been divided, and the saphena vein drawn to one side with a strabismus hook, and any of its branches divided between double ligatures, the sartorius is identified by the direction of its fibres and drawn to the inner side. The canal is next opened by dividing the aponeurotic roof, and the artery or its pulsation felt for. The vessel will be found closely connected to its vein, which lies behind it, while the saphenous nerve crosses it from without inwards. The artery having been most carefully cleaned all round, the ligature may be passed from either side, as is found most convenient.†

Causes of Failure after Ligature of the Femoral.

1. Gangrene. 2. Secondary Hæmorrhage.—If pressure fail, an attempt must be made to re-tie the vessel, and, this not succeeding, the limb must be amputated. 3. Suppuration of the Sac of an Aneurysm.—This is very rare. 4. Recurrent Pulsation in the Aneurysm.—The premature softening of the ligature, especially in a septic wound, must always be remembered as a possible cause of this. Pressure failing, the artery may be tied lower down. 5. A very rare complication is the formation of an aneurysm at the seat of ligature.

AMPUTATION THROUGH THE THIGH (Figs. 243-246).

Practical Points in Amputation of the Thigh.—As the soft parts behind are more bulky than those in front, and as it is desirable to place the bone as near as possible in the centre of the soft parts, the back of the thigh, in the case of a bulky limb, may be supported by the hand of an assistant during the first introduction of the knife to form the anterior flap (Skey). Amputation should always be performed as low down as possible, not only to avoid shock and to secure as long a stump as possible for the artificial limb, but also to secure as much as possible of the rectus femoris. This muscle is a most important agent by which the thigh is put forward in stepping. Its division does not preclude the retention of its office, as it acquires a sufficient adhesion to the material of the stump to answer every useful purpose, as an agent in the flexion of the thigh on the pelvis, though that of extension of the leg be destroyed (Skey, *Oper. Surg.*, p. 391).

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* This incision must not be made too low down. Its centre should correspond to the centre of the thigh.

† Much difficulty will be met with in tying the femoral artery in Hunter's canal unless the line of the artery (p. 611) is strictly followed. A common mistake is to make the incision too far out, thus exposing the fibres of the vastus internus, which run downwards and outwards, instead of those of the sartorius, which run downwards and inwards (Smith and Walsham, *Man. of Oper. Surg.*, p. 83). Sir J. E. Erichsen (*Surgery*, vol. ii. p. 250), who gives as the line of the artery, one drawn from a point exactly midway between the anterior superior spine and the symphysis pubis to the most prominent part of the internal condyle, insists on the need [illegible] the incision a finger's-breadth internal to this. The line which I [illegible] be found sufficiently internal.

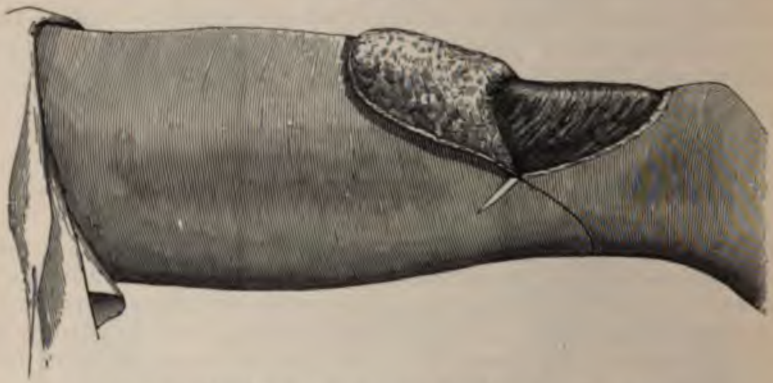
Different Methods.—The following five, which will give ample choice, will alone be described here; the first is especially recommended:

I. **Mixed Antero-posterior Flaps and Circular Division of the Muscles.** II. **Antero-posterior Flaps by Transfixion.** III. **The Circular Method.** IV. **Rectangular Flaps.** V. **Lateral Flaps.**

I. **Mixed Antero-posterior Flaps and Circular Division of the Muscles** (Fig. 243).—By the term mixed is meant an anterior flap of skin and fasciæ raised from without, and a posterior one made by transfixion. The anterior is, wherever practicable, made the longer of the two.

This method has the following great *advantages:* (1) The longer anterior flap falls well over the bone, and thus keeps the scar behind; (2) being raised from without inwards, it can be taken from the neighbourhood of the knee-joint and patella; (3) it is a most expeditious method,* almost as quick as that by double transfixion flaps; (4) it is suited to all cases, save perhaps those of very muscular thighs, where the surgeon should be careful to take only part of the muscles behind as he transfixes, or else should raise his posterior flap also from without inwards: (5) it gives good drainage.

FIG. 243.



The knife should have been inserted here from the inner side.

Operation.—The femoral artery having been controlled with an Esmarch's bandage,† the limb being brought over the edge of the table, and supported by an assistant, who has bandaged the damaged or diseased part to give his hands a firmer grip, and to prevent their becoming septic; the opposite ankle being tied to the table, and the parts duly cleansed, the surgeon standing to the right side of the limb to be removed, places his left index and thumb on either side of the limb, at the level where he intends to saw the bone,‡ and sinking the point of his knife through the skin just below the former and rather below the centre of the outer or inner aspect of the limb, as the case

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[*] As in railway and other accidents.

[†] If the surgeon is amputating very high up, the method given in the account of amputation at the hip-joint (p. 579) may be used.

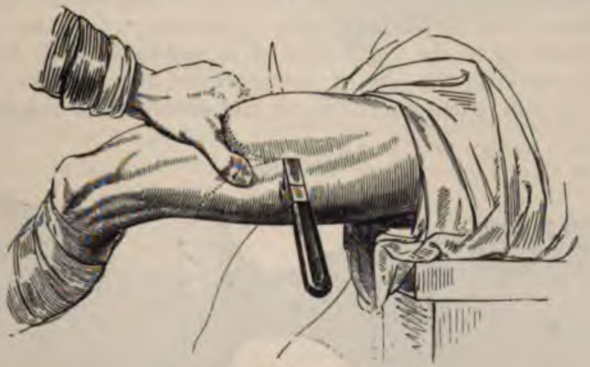
[‡] The finger and thumb should not be shifted till the anterior flap is marked out.

may be, carries it rapidly down for about four and a half inches, and then sweeps it across the limb with a broad, not pointed, convexity, and carries it up along the side nearest to him as far as his thumb. A flap of skin and fascia is then quickly dissected up, and the knife, being sent across the limb, behind the bone, cuts a posterior flap almost as long as the anterior, the knife being used with a rapid sawing movement, and driven at first straight down parallel with the bone, and then sharply brought out through the skin.

The flaps being held out of the way with the surgeon's left hand,* the soft parts around the femur are next severed with circular sweeps† till the bone is exposed, when one more firm sweep divides the periosteum.‡

The saw is now placed with its heel on the bone and drawn towards the operator once or twice with firm pressure so as to make one groove, and one only. With a few sharp sweeps the bone is next severed, care being taken to use the saw lightly for fear of splintering the linea aspera, and to use the whole length of the instrument. At this time the limb must be kept steady and straight, the assistant neither raising it, which will lock the saw, nor depressing it, which will splinter the femur when this is partly divided.

FIG. 244.



(Fergusson.)

If the surgeon decide to make his posterior flap also of skin and fasciæ, he must have the limb raised, and first looking over and then stooping down, he marks out a skin flap about two-thirds the length of the anterior; this is then dissected up, and the operation completed as before.

In addition to the femoral vessels, the anastomotica, and descending branch of the external circumflex, some muscular branches will require attention; and one of these last may give some trouble from its position close to the bone, in contact with the linea aspera.

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* And also pressed firmly upwards, so as to enable the saw to be applied as high up as possible. If the limb is bulky an assistant must help here.

† This requires really forcible use of the knife, the muscles behind the bone tending to be pushed before the knife rather than divided by it.

‡ This final cut should be a little above the base of the flaps, in order that the sawn femur may lie well buried in soft parts.

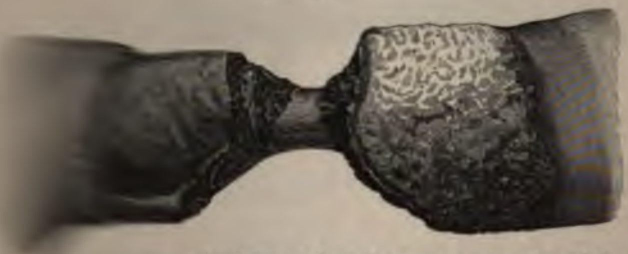
[illegible] deserve attention in tying the femoral vessels: [illegible] saphenous nerve; (2) the tendency of the vessels [illegible] of their division passes through Hunter's canal; [illegible] they must not be tied too tightly. A [illegible] not too fine, should be employed now, and care [illegible] include a little of the soft parts so as to prevent the [illegible]

[illegible] thigh accompanied by grave shock, no needless [illegible] looking for vessels, save the femoral and any other [illegible] Firm bandaging and raising the stump [illegible] is well to partially relieve the tightness of the bandages [illegible] them. Very few sutures should be used in [illegible] those where the soft parts are sinus-riddled.

[illegible] (Fig. 244).—*Advantage.*—Great rapidity. [illegible] given at p. 73, Vol. I., on a large scale. This [illegible] where great speed is needed, as in a double [illegible] railway accident, or where many wounded require [illegible] great battle. It is also adapted to the wasted [illegible] who has long suffered from some chronic disease of [illegible] here it is inferior to the mixed method.

[illegible] The preliminary steps given at p. 620 being taken, the [illegible] the right side of either limb, with his left index [illegible] the site of his intended bone-section, raises with [illegible] on the front and sides of the thigh, and sends

Fig. 245.



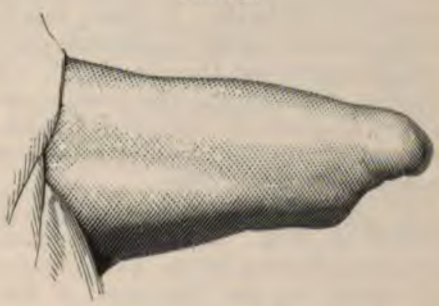
[illegible] of the thigh to show the greater retraction of the muscles behind.

[illegible] limb in front of the femur. The knife should be [illegible] as to get as large an anterior flap as possible, and, [illegible] be pushed a little upwards so as to go easily over [illegible] flap is then cut four to four and a half inches [illegible] curving almost square extremity, and not too thin [illegible] being raised by the surgeon or an assistant, the knife [illegible] the bone, and a posterior flap cut of the same [illegible] the making of this flap being somewhat facilitated [illegible] parts on the back of the limb away from the bone. [illegible] very bulky, the knife should be kept well away from [illegible] especially behind it, and not as in Fig. 244; thus the more [illegible] muscles only will be included in the posterior flap. [illegible] having been retracted, the remaining soft parts are severed [illegible] and the rest of the operation completed, as at

p. 621, but with this difference, that here there will be more need of trimming some of the soft parts clean and square.*

III. **The Circular Method.**—I may here state briefly why this method is, nowadays, considered inferior, both in the thigh and elsewhere, to that by flaps. In saying this, it is not denied that in many cases stumps by the circular method are fully equal to those by flaps; indeed, in many it is impossible to tell, in later years, which method has been employed. On the whole, however, the *flap-method* has the following *advantages:* (1) It is most generally applicable—*e.g.*, in most parts not circular and at the joints.† (2) By it the surgeon can better adapt his skin covering to his needs—*e.g.*, when the skin is less available on one aspect of the limb than on another. (3) There is less risk of a conical stump; and (4) of a cicatrix adherent to the bone. The great advantage of the circular method—viz., that the vessels and nerves are cut square, and that, thus, the former retracting more easily, fewer need securing, while there is less risk of bulbous ends forming on the latter—is attained by the mixed method of skin flaps and circular division of the muscles as advised at p. 620.‡

FIG. 246.



Inner aspect of the stump of a left thigh, amputated by the circular method. The powerful tendency of the posterior muscles to retract has not been allowed for, and the stump, in consequence, is conical. (Farabeuf.)

The circular method is only to be adopted here in the case of the lower third of wasted thighs, or in those of young subjects. Even here the greater tendency of the posterior muscles to retract (Fig. 245) must be met by cutting them about three-quarters of an inch longer than those in front.

While this operation is for the above reasons not recommended in practice, it may be made use of in the lower third of the thigh in the cases mentioned above. On the dead subject the student who has not had a chance of performing it upon the arm may make use of it here.

Operation.—As this method has been described in detail at p. 77 Vol. I.§ it will be only briefly given here. The preliminaries are those already given. The surgeon standing to the right of the limb, the assistant, who stands on the opposite side to him, but nearer the trunk, draws up the skin with both hands. The surgeon, stooping a little, passes his knife first under the limb, then above, across, and so around it till by dropping the knife vertically the back of the instrument looks towards him, while its heel rests on that side nearest to him. He then makes a circular sweep around the thigh, this being aided by the assistant who has charge of the limb, rotating it so as to make the soft parts meet the knife. The surgeon then taking hold of the edge of the incision dissects up a cuff-like flap, about four and a half inches in length, cutting it of even thickness all round the limb. The flap is then folded back, and the remaining soft parts divided with circular sweeps of the knife. In doing this the greater contraction of the hamstring muscles must be remembered (Fig. 245), and these muscles cut rather longer than those in front. Care must be taken, if it is thought needful, after making the circular sweeps, to free the bone higher up, and so to secure its being well buried in the soft parts, but not to prick the already divided femoral vessels which lie in close proximity to the femur in the lower third.

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* While dresser to the late Mr. Poland, I once saw the femoral vessels split for about three and a half inches by his rapid hands. This amputation of the thigh was his last operation at Guy's Hospital. He was even then facing with quiet bravery the bronchitis which a very few days later, ended his life.

† To these it may be added that the circular method is not adapted to a case where the skin is matted to the subjacent muscles.

‡ One more advantage of the flap-method is the greater rapidity, especially when transfixion is employed, though this, in these days of anæsthetics, is only of importance in a few cases.

§ If it be objected that the plan here given of turning up a cuff-life flap is likely to lead to sloughing, I would reply that this is not so in these days of antiseptic surgery. If sloughing is dreaded, a little more time should be taken in dissecting up a thin layer of muscle, so as to secure a deep fascia and thus a better vascular su

IV. **Rectangular Flaps of Mr. Teale.**—This method is fully described p. 674. It is not recommended here as it is expensive, involving division of the bone nearer to the trunk than other methods. (1) Owing to the bulkiness of the long anterior flap, it is, here, especially difficult to fold and adjust it at the conclusion of the operation, and, still more so, to keep it adjusted if primary union fails. (2) Its chief advantages—keeping the end of the bone well buried, and cutting the vessels and nerves clean and square—are also sufficiently attained by the other flap methods already given, especially the mixed method (p. 620).

V. **Lateral Flaps.**—This method has certain grave objections here. (1) The sawn femur, tilted upwards by the ilio-psoas, is very liable to press against the upper angle of the flaps, and to come through at the spot and necrose. (2) If this does not take place, the bone often adheres to the cicatrix here, while the flaps hang down and away from it.

It should only be made use of when no other method is available, as in a case where, owing to the condition of the soft parts, flaps can only be got by making one long external and a short interval, or *vice versâ*.

Operation.—This method will be found fully described at p. 673.

AMPUTATIONS IMMEDIATELY ABOVE THE KNEE-JOINT (Figs. 247–255).

Methods.

i. **Carden's** (Figs. 247, 248, 249). ii. **Gritti's Trans-condyloid** (Figs. 250, 252, 254). iii. **Stokes's Supra-condyloid**, an important modification of the above (Figs. 251, 253, 255).

All the above, but especially the two latter, possess the following *advantages* (which they share with amputation through the knee-joint) over amputation through the thigh, viz.:—

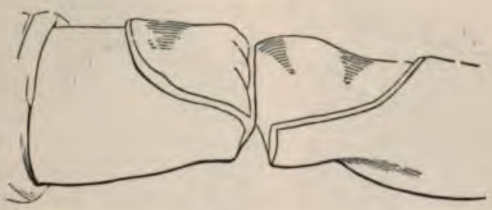
1. The patient can bear his weight in walking on the face of his stump; thus, he is not compelled to take his bearing from the

tuberosity of the ischium, or to walk as if he had an ankylosed hip-joint (Stokes), as is the case after amputation of the thigh, where the stump is ever liable to be fretted by the slightest pressure on it. 2. Very good power of adduction over the artificial limb remains. Every surgeon must have noticed how badly off a patient is in this respect after an ordinary amputation through the thigh. By these methods the adductors are left almost intact, even to part of the strong vertical tendon of the adductor magnus, the result being that the balance between the adductors and the abductors of the thigh remains practically undisturbed, and the patient when walking has none of that difficulty (which is seen after thigh amputations) of bringing the limb which he has swung forwards, in again under the centre of gravity.* 3. The medullary canal is not opened; on this account there is less risk of necrosis and osteo-myelitis if the stump becomes septic. 4. There is less shock, because (*a*) the limb is removed farther from the trunk, (*b*) the muscles are divided not through their vascular bellies, but through their tendons.

i. **Carden's Amputation** (Figs. 247, 248, and 249).

Advantages.—This valuable amputation has some points in common with Syme's amputation at the ankle-joint. In both the bone-section is made not through a medullary canal, but through vascular, quickly-healing cancellous tissue; in both, the skin reserved for the face of the stump has been used to pressure, though not equally so, for the skin preserved in the ankle-amputation is thick and callous, in the other thinner and more sensitive.

FIG. 247.



(Carden.)

Lord Lister (*System of Surgery*, vol. iii. p. 705) thus recommends this amputation: "This operation, when contrasted with amputation in the lower third of the thigh, presents a remarkable combination of advantages. It is less serious in its immediate effects upon the system, because a considerably smaller quantity of the body is removed, and also because the limb, being divided where it consists of little else than skin, bone, and tendons, fewer blood-vessels are cut than when the knife is carried through the highly vascular muscles of the thigh; the popliteal and one or two articular branches being, as a general rule, all that require attention, so that loss of blood is much diminished. In the further progress of the case the tendency to protrusion of the bone, which often causes inconvenience in an amputation through the thigh, is rendered comparatively slight by the ample extent of the covering provided, and also by the circumstance that the divided hamstrings slip up in their sheaths, so that the posterior muscles have comparatively little power to produce retraction. The superiority of the operation is equally conspicuous as regards the ultimate usefulness of the stump, which, from its great length, has full command of the artificial limb, while its extremity is well calculated for sustaining pressure, both on account of the breadth of the cut surface of the bone divided through the condyles, and from the character of the skin habituated to similar treatment in kneeling. Considering therefore that this procedure can be substituted for amputation of the thigh in the great majority of cases both of injury and disease formerly supposed to demand it, 'Carden's operation' must be regarded as a great advance in surgery." *

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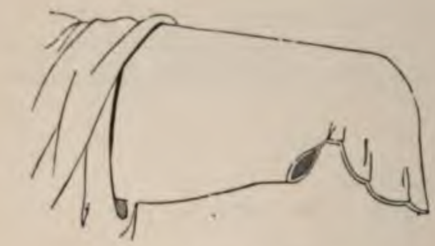
* The importance of the preservation of the quadriceps extensor, given by the Stokes-Gritti method, need only be alluded to.

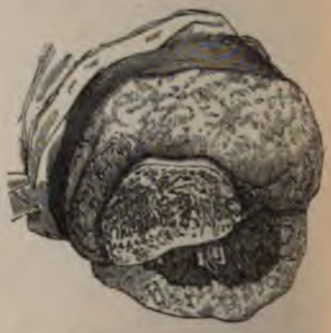
Disadvantages.—The chief of these is the sloughing of the long anterior flap which may occur, "in spite of faultless operating," especially if the skin, of which it chiefly consists, has been damaged by injury or disease, or if the patient be old or weakly, thus leading to an adherent, tender scar, and a useless stump.

Fig. 248.



(Carden.)

Fig. 249.



Operation.—According to its introducer this amputation consists in removing a rounded flap from the front of the joint (Figs. 247 and 248), dividing everything else straight down to the bone, and sawing this slightly above the plane of the muscles.

The operator, standing on the right side of the limb, takes it, between his left forefinger and thumb, at the spot selected for the base of the flap,† and enters the point of his knife close to his finger, bringing it round through the skin and fat below the patella to the spot pressed by his thumb, then turning the edge downwards at a right angle with the line of the limb, he passes it through to the spot where it first entered, cutting outwards through everything behind the bone. The flap is then reflected, and the remainder of the soft parts divided straight down to the bone; the muscles are then slightly cleared upwards, and the saw applied "through the base of the condyles." The projecting part of the femur may be rounded off. Where there is any doubt about the vitality of the large anterior flap, a short posterior one should be made, the anterior one thus not needing to be so long.

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* Other advantages given by Mr. Carden are, the favourable position of the stump for dressing and drainage; its painlessness, the chief nerves being cut high up and slipping upwards out of the way; and the cicatrix being drawn clear of the point of the bone, and out of reach of pressure.

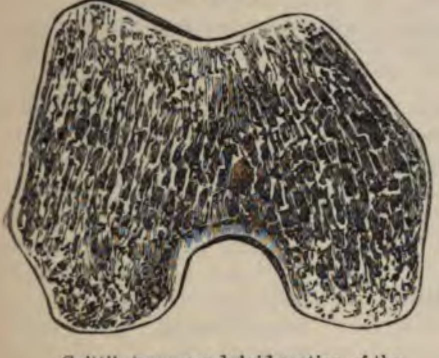
† This corresponds with the upper border of the patella, the limb being extended. The lower margin comes down to the tubercle of the tibia, as in Fig. 247. (See also *Brit. Med. Journ.*, 1864, vol. i. p. 416).

ii. **Gritti's Trans-condyloid** (Figs. 250, 252, and 254). iii. **Stokes's Supra-condyloid Amputation** (Figs. 251, 253, and 255).

For fuller information on the above amputations I would refer my readers to a paper I contributed to the *Guy's Hosp. Reports*, vol. xxiii. p. 211, 1878. The objections to amputations through the knee-joint, whether by a long anterior, or long posterior flap, are given at p. 632. Amputation through the knee-joint by lateral flaps gives excellent results, but in this method the incisions are carried into the leg below the tibial tubercle; in the two amputations mentioned above this level is not trenched upon, and every surgeon knows that after a severe compound fracture of the leg, an inch or two more or less of damage to the soft parts in the upper third of the leg makes a most important difference as to where he can amputate.

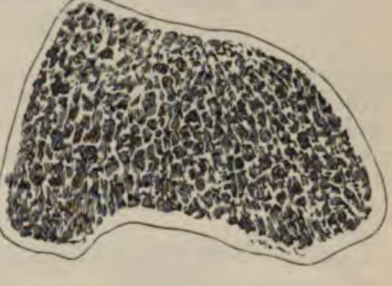
The two methods are often confused. Between them there is this all-important difference: in Gritti's the section of the femur is made *through* the condyles; in Stokes's, at least half-inch *above* them. In other words, the one operation is *trans-*, the other *supra-condyloid*.

FIG. 250.



Gritti's trans-condyloid section of the femur, leaving a surface much too long and large for the sawn patella to fit.

FIG. 251.

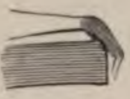


Stokes's supra-condyloid section of the femur, leaving a surface much more easily fitted by the sawn patella.

On this point great stress has been laid, and very rightly, by Sir W. Stokes, and a comparison of the two operations will convince every one that he is correct. If the section of the femur be made through the condyles (Figs. 250, 252), the sawn patella will not fit down into place. It will either be drawn up altogether on to the front of the femur, or else will project forwards, somewhat like the half-open lid of a box (Figs. 252, 254), at an angle to the broad sawn surface, which is also too large for it to cover, and across, and off which it is liable to be shifted by the contraction of the quadriceps, if it has been found possible to get it into place. To effect this, an amount of force will be required which is almost certain to result in bruising of the cut periosteum on the edge of the femur, and consequent necrosis. If, on the other hand, the saw is made to pass a full inch *above* the condyles (Fig. 251), the patella will fall readily into place (Fig. 253), it will cover more completely the now smaller surface of the femur, and will remain easily *in situ* here, the flaps when brought together presenting the appearance shown in Fig. 255.

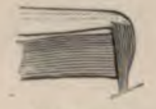
Operation.—An Esmarch's bandage having been applied, the limb brought over the edge of the table and supported, and the opposite one secured out of the way, the surgeon, standing to the right of the limb, with his left index and thumb marking the base of the flap, makes an incision commencing (on the left side) an inch above and rather behind the external condyle, carried vertically downwards to a point opposite to the tibial tubercle, then broadly curved across the leg and carried upwards to a point opposite to that from which it started. This flap having been dissected upwards, together with the patella (after section of the ligamentum patellæ), a posterior flap is cut nearly as long as the anterior. This may be effected in one of two ways, either by the surgeon looking over and then stooping a little (the limb being now raised), next drawing the knife from without inwards across the popliteal space, thus marking out and then dissecting up a skin flap, or by transfixing and cutting the flap from within outwards. Of the two I prefer the first: the latter is the speedier, but less suited to bulky limbs. The flaps being retracted, the soft parts are cut through with a circular sweep a full inch above the articular surface of the femur, the bone is then sawn through here, and the limb removed. The posterior surface of the patella is next removed with a metacarpal or small

Fig. 252.



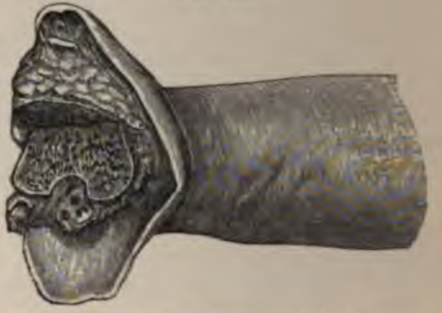
(Farabeuf.)

Fig. 253.



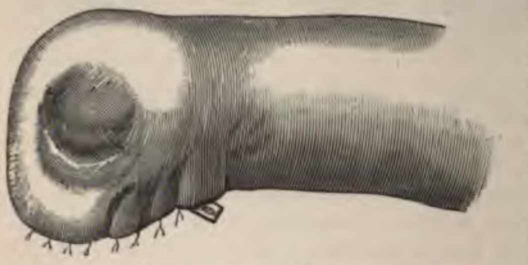
(Farabeuf.)

Fig. 254.



The flaps in Gritti's trans-condyloid amputation, showing the patella hitched and requiring force to adapt it to the femur, which is now too long as well as too broad.

Fig. 255.



Appearance of the stump in a Stokes-Gritti's amputation. The patella has come easily into place. The drainage-tube shown might, in many cases, be dispensed with.

Butcher's saw. This last step is the only difficult one in the operation, owing to the mobility of the bone; it will be facilitated by an assistant with both his hands everting and projecting the under surface of the anterior flap, so as to make the patella stand out from it.

The vessels—popliteal, one or two articular, and the anastomotic—having been secured, drainage is provided, and the flaps are brought together with numerous points of suture, save at the angles (Fig. 255).

Where the flaps are cut of proper length and the femur is sawn at the proper height, it is quite exceptional for the patella not to ride easily *in situ*. If there seem any doubt on this point, or if the patient is very muscular, additional security may be given—(*a*) By passing sutures of chromic gut or carbolised silk between the tissues on the under surface of the anterior flap, at the edges of the patella, and the soft parts in the posterior flap (avoiding the vicinity of the large vessels); (*b*) by wiring or pegging the bones; (*c*) by dividing the rectus muscle on the under surface of the anterior flap. Of these, wiring or pegging is the best; the pegs must be scrupulously clean, and should be well boiled beforehand. An ordinary bradawl, also rendered aseptic, will be found quite as efficient as a drill.

REMOVAL OF AN EXOSTOSIS FROM NEAR THE ADDUCTOR TUBERCLE.*

As these growths are by no means uncommon in adolescents, this operation will be briefly described here. Aseptic excision has now replaced any other operation, such as subcutaneous fracture.

Operation.—The parts having been thoroughly cleansed, the knee is flexed so as to bring down the synovial membrane, and the limb placed on its outer side. A free incision, about three and a-half inches long, is made over the growth, down to the vastus internus, and any superficial vessels attended to. The muscular fibres are then cleanly cut through, and the bluish-grey cartilage which caps the swelling now comes into view.† Any muscular branches being now carefully secured, and the wound sponged dry, the cut vastus is pulled aside with retractors, and the growth being thoroughly exposed it is shaved off with an osteotome or chisel, leaving exposed cancellous tissue. A little iodoform is dusted in, and, if needful, drainage provided by a tube or large horsehair drain, passed from the wound to the most dependent spot on the inner side, the dressing-forceps passing under the muscle and being cut down upon by counter-puncture, where they project under the skin. The muscular fibres are then united with chromic gut, and the wound closed with separate sutures. Strict aseptic precautions are taken throughout to secure primary union. The limb should be kept absolutely quiet on a back splint, and a Martin's bandage worn, later, for a short time.

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* This account will serve for the removal of other exostoses—*e.g.*, those met with at the deltoid insertion, the spine of the scapula, or the pelvis.

† Any synovia-like fluid now escaping comes probably from a bursa over the growth, not from the joint.

UNUNITED FRACTURE OF THE FEMUR.

The large number of failures after operations for this condition are well known. The difficulties which may be present during and after these operations are very considerable; amongst them sufficient exposure of the fragments, keeping the wound aseptic, and the parts in correct apposition afterwards (*vide infra*), are most prominent.

Operation.—On the whole, the introduction of pegs having been less successful, sub-periosteal resection and fixation of the fragments is indicated here.[*] This is especially so in long-standing cases, where other methods have failed, where there is very little attempt at repair, where an artificial joint exists, or where, after a severe injury, necrosis, atrophy of the fragments, and fibrous union have followed.

The operation of resection should always be performed with strict aseptic precautions, otherwise the risks of suppuration, erysipelas, osteo-myelitis, and pyæmia, owing to the very free incision required, the exposure of cancellous tissue, and, perhaps, of the medullary canal, are considerable.

The following most important preliminary points are given by Sir F. Treves (*Oper. Surg.*, vol. i. p. 588). "(1) It will be well in some cases to apply extension for a week or two before the operation; this overcomes the shortening produced by contracted muscles, and enables the surgeon to make trial of the splint he proposes to employ afterwards. (2) Before undertaking this operation the surgeon should understand that its success depends more upon the completeness of the arrangements that are made for keeping the bones in position after the operation than upon the operation itself, provided the latter be carried out with due care. . . . . Care in the adjusting of the fragments, and infinite and continued care in the after-treatment, are the main elements of success in the present class of case. (3) In dealing with a fracture of the femur in an adult, it is well that the operation be performed as the patient lies upon the bed he will occupy throughout the whole treatment. Much moving of the patient after the operation is very undesirable, and a long thigh-splint without extension apparatus cannot be conveniently applied upon the operation table." The limb having been rendered bloodless, if practicable, with Esmarch's bandages,[†] the fracture is exposed by a free incision, five to six inches long, on the outer side of, and going down to, the bone. The periosteum is next most carefully detached from the ends of the fragments, and a thin layer of bone, about a quarter of an inch in thickness, removed from each. To facilitate the resection, the fragments may be thrust out of the wound, or, after the removal of the periosteum, dragged out and steadied with sequestrum-forceps before the saw is applied. The soft parts must be protected with spatulæ and retractors while the ends of the bone are removed with a narrow-bladed saw. The fragments are now brought into exact apposition, and to facilitate this it may be necessary to divide adhesions or tendons, or to remove any intervening fibrous or fibro-cartilaginous material, or a sequestrum. If the fragments are successfully adjusted and carefully kept so (*vide supra*), the use of wire, pegs, and screws may be dispensed with. Their use, although it ensures correct apposition of the fragments, prolongs and complicates the operation, and may give considerable trouble later on. If it be determined to make use of wire, the ends are now to be drilled, the drill being entered on the superficial surface of each fragment, and then made to project in the centre of the medullary canal. They are next held together by passing very stout* silver wire through the drill-holes, and twisting this up. If the wire is to be removed, three or four half-twists or two complete twists should be sufficient. If the surgeon prefer, he may hammer it down, *in situ*, having made three half-twists and cut the ends short. See the remarks, p. 654. Other methods that may be found superior to wire are Mr. W. A. Lane's screws, p. 683 (*Clin. Soc. Trans.*, 1894), and Prof. Senn's hollow perforated bone cylinders or ferrules. These are circular or triangular, and large enough to slip easily over the fragments. The most accessible fragment having been sufficiently isolated, the ferrule is slipped over it and far enough away from the line of fracture to clear the other fragment. After reduction has been accomplished the second fragment is engaged in the ring, which is then pushed back sufficiently far to grasp both fragments securely. If the ferrule rides too loosely, any space should be packed with chips of decalcified bone. The limb is put up in plaster of Paris. If suppuration occur, the ferrules are removed by cutting through one side with bone forceps, after enlarging the sinus, when the parts are consolidated. If there is no suppuration, the ferrule will probably be absorbed (*Ann. of Surg.*, vol. ii. 1893, p. 125).

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[*] Lord Lister has recorded (*Brit. Med. Journ.*, Aug. 26, 1871) the case of an ununited extra-capsular fracture of the femur in a man, aged 45, where, eighteen months after the injury, he cut down on the fragments, with antiseptic precautions, and gouged them, the fracture being then finally put up. Recovery was complete, the man walking well.

[†] This step is condemned by some, notably by Sir F. Treves (*loc. supra cit.*, p. 588). I admit that it leads to much oozing from the cut surfaces, but, having tried both ways, I am of opinion that this can be safely met by applying ample well-adjusted dressings before the bandage is removed, and that the advantage of a bloodless wound during a most difficult and prolonged operation is almost incalculable.

The special bone clamp devised by Dr. Clayton Parkill has also been used successfully in a number of cases. A full account of the clamp and its various uses is given in the *Ann. of Surg.*, May 1898. Here will be found also the reports of fourteen cases in which the clamp has been used. The fact that success was obtained in each of these cases constitutes a strong claim for a more extended trial.

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* About one-tenth of an inch in thickness, so as to withstand the strain of the muscles of an adult thigh.

CHAPTER IV.

OPERATIONS INVOLVING THE KNEE-JOINT.

AMPUTATION THROUGH THE KNEE-JOINT.—EXCISION OF THE KNEE-JOINT.—ARTHRECTOMY OF THE KNEE-JOINT.—WIRING THE PATELLA.—REMOVAL OF LOOSE CARTILAGES FROM THE KNEE-JOINT.—SLIPPED FIBRO-CARTILAGES.

AMPUTATION THROUGH THE KNEE-JOINT (Fig. 256).

Chief Methods.

I. **By Lateral Flaps.** II. **By Long Anterior and Short Posterior Flaps.**—Of these the first is far the superior. The great objection to the second is, that in order to get sufficient covering to fall readily over the large condyles, a long anterior flap must be cut; as this must reach two inches below the tibial tubercle, a good deal of its blood-supply which comes from below—*e.g.*, from the recurrent tibial, must be cut off, and the flap is thus liable to slough. This risk is much diminished, and the blood-supply better equalised, by the method of lateral flaps.

I. **Amputation by Lateral Flaps.**—This, the method of Dr. Stephen Smith,* was brought before English surgeons by Mr. Bryant.† The femoral artery having been controlled, the limb supported over the edge of the table, and slightly flexed, the surgeon, standing on the right side of either limb, marks out two broad lateral flaps as follows: His left thumb and index finger being placed, the former over the centre of the head of the tibia, the latter at the corresponding point behind, opposite the centre of the joint, he marks out (in the case of the right limb) an inner flap by an incision which, commencing close to the index finger, is carried down along the back of the limb for about three inches and a half, and then curves upwards and forwards across the inner aspect of the leg, till it ends in front just below the thumb.‡ The knife not being taken off, a similar flap is then shaped from the outer side, but in the reverse direction. Dr. Stephen Smith calls attention to the following points: In making these flaps, they should be cut broad enough to secure ample covering for the condyles, and the inner one should be made additionally full as the internal condyle is longer than the external. The flaps should be at least three inches and a half long, if of equal length. They consist of skin and fasciæ. When they have been raised as far as the line of the articulation the ligamentum patellæ is severed, allowing the patella to go upwards. The soft parts around the joint are then cut through with a circular sweep, and the leg removed. In doing this, the limb being flexed to relax the parts and facilitate opening the joint, the semilunar cartilages will very likely be found closely encircling the condyles of the femur. Mr. Bryant, in the paper already quoted, and Dr. Brinton (*Philad. Med. Times*, Dec. 28, 1872), as long ago as 1872, have strongly advised that the semilunar cartilages should be left *in situ* by severing the coronary ligaments which tie them to the tibia. They thus, in Dr. Brinton's words, form "a cap, fitted on the end of the femur, which preserves all the fascial relations, effectually prevents retraction, and guards against the projection of the condyles." This precaution will obviate a serious objection to amputation through the knee-joint. For a time the patient bears his weight well on the end of the stump. But after some months the ends of the condyles (if unprotected by the menisci) begin to fret the thin overlying skin, and within a year of the amputation the patient, usually, has to have his artificial limb altered.

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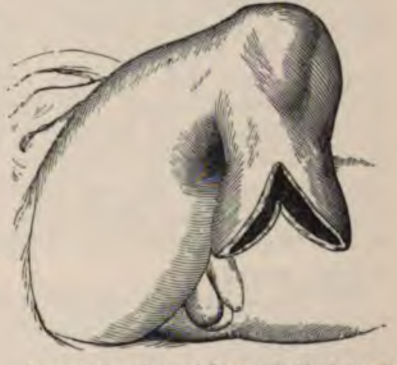
* *New York Journ. of Med.*, Sept. 1852; *Amer. Journ. Med. Sci.*, Jan. 1870.

† *Med.-Chir. Trans.*, vol. lxix. p. 163.

‡ Dr. S. Smith begins his incision about an inch below the tubercle of the tibia, and carries it up rather higher behind—viz., to the centre of the articulation. It will be found easier to open the joint and to detach the semilunar cartilages from the tibia by making the incision as recommended above.

FIG. 256.



Amputation through knee-joint by lateral flaps. The incision has been begun unusually low down. (Bryant.)

Mr. Pick's (*Med. Soc. Proc.*, 1884, vol. vii. p. 134) modification of the above operation is twofold—viz. (1) He begins his incision higher up—*i.e.*, at the upper border of the patella; and (2) he removes the patella. This last would appear likely to run the risk of damaging the blood-supply.

II. **By a Long Anterior and a Short Posterior Flap.**—The position of the patient and the surgeon being as at p. 632, the latter with his left index and thumb on either side of the interval between the femur and tibia, enters his knife (in the case of the right limb) just below the finger and internal condyle, carries it straight down along the inner side of the leg till it reaches a spot two inches below the tibial tubercle,* then squarely across the leg till it reaches a corresponding point well back upon the outer side, and thence up to a point just below his thumb, or to the external condyle. This flap is then dissected up, containing the patella, as thickly as possible, and almost rectangular in shape, anything like pointing of its lower end being most carefully avoided, as certain to lead to sloughing.

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* Mr. Pollock (*Med.-Chir. Trans.*, vol. liii. p. 20) advises that the anterior flap should reach "quite five inches below the patella." It is difficult to see how sloughing can be avoided here, so much of the blood to this very long flap coming from below and being, of necessity, cut off.

This flap being raised, a posterior flap is made about two-thirds the length of the first, as at p. 628, either by dissection from without inwards, or by transfixion after disarticulation.

EXCISION[*] OF THE KNEE-JOINT

(Figs. 257 and 258).

Indications.—A. FOR DISEASE. B. INJURY.

A. (i.) Pulpy. Tubercular knee.

This condition, being the most frequent indication for excision of the knee, calls for most careful consideration of the following points:—

(1) *Safety and Amount of Risk.*—Lord Lister's treatment, by removing sepsis, has rendered excision of the knee practically safe in properly selected cases. No surgeon who is familiar with careful antiseptic treatment and excision of the knee will say that the above is too strong a statement.[†] Excision here contrasts very sharply with the same operation at the hip, from the much greater facilities for getting away all the disease at the time, and for getting at and examining the wound later, together with the greater ease with which the wound here is kept aseptic.

(2) *Age.*—Here the operation has to be considered—(*a*) as a substitute for amputation; (*b*) as a substitute for the expectant treatment. While excision may be successfully employed at any age up to thirty, and even occasionally in older[‡] patients, I consider the most favourable years to be from about fifteen to twenty. Before fifteen, and particularly before ten, we have especially to consider the effect of the operation on the growth of the bone; after twenty we have more and more to consider the condition of the patient, the state of the viscera, general vitality, &c. I would ask my reader's careful attention to these points—(1) that the chief growth of the femur takes place at its lower end (p. 594); (2) that by fifteen, and still more by seventeen, the growth of the bone is largely completed. It follows from the above remarks that in young subjects, especially before ten, as little of the bones as possible should be removed, and that gouging should largely replace the saw.

(3) *Rank of Life.*—Excision of the knee being almost unknown in private practice, it is needless to remark that this account of the operation

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[*] This operation is contrasted with arthrectomy of the knee at p. 650.

[†] I may perhaps here say that up to 1897 I excised the knee seventy-seven times, and performed arthrectomy on eighteen occasions. Of the cases of excision four died of effects of the operation, one (mentioned below) from shock, another (also mentioned below) from threatening gangrene, a third from surgical scarlet fever, and the fourth from septicæmia. The child with surgical scarlet fever was moved, during my absence from town, into an empty, chilly ward; the eruption became dusky and then suppressed; coma, followed by death, ensued. Six have been submitted to amputation, making good recoveries. This number would probably have been seven, as a patient, aged 53, whose knee had been excised for disorganisation after osteo-arthritis and whom I had advised to submit to amputation, went out able to walk a little with a stick, but with two sinuses.

[‡] See the remarks on osteo-arthritis (p. 637).

refers almost entirely to hospital patients. Let me briefly, though imperfectly, depict the usual fate of these patients with pulpy knee *if not excised early*. Bandied about from one out-patient room to another, treated more or less imperfectly with splints and strapping, frequently recommended for admission that they may obtain that "rest" which can nowhere else be carried out, at last the "dresser for the week," or surgeon, takes pity on the case and it is admitted. With what result? As soon as the inflammation has subsided and the pain has ceased, the child is thought to be occupying a bed which can be better employed for clinical teaching, and, after a few weeks' rest in bed, is turned out again, perhaps in plaster of Paris or a Thomas's splint. A little later, in the rough-and-tumble life of the courts and alleys of our large towns, the joint is wrenched, and the good gained is all undone. Suppuration now sets in at one or more points of the pulpy tissue, sinuses form, the ends of the bone become carious, and the condition of the joint from the now advanced stage of the disease, and its probably septic condition, is rendered far less favourable for any operation than it was at an earlier stage. To speak briefly, believing, as I do, that in this rank of life excision will be needed in nine cases out of ten, I am of opinion, most distinctly, that, as soon as a pulpy condition is declared, excision or erasion (or, if needed, both combined) should be performed while the state of the joint and the general condition of the patient are, alike, favourable.

If the surgeon desires to have a time-limit at which it is justifiable to resort to excision he may remember the dictum of Mr. Howse (*Guy's Hosp. Reports*, 1894): "When a well-marked case of pulpy disease has lasted over six months, it is not worth while to attempt the conservation of the joint for a longer period." Under these conditions "we best consult the patient's interests by excising the joint on these grounds: (1) That the chances are very much in favour of the continued progress of the disease; (2) That even if the disease does not progress it will leave a damaged weakened joint, very liable to outbreaks of trouble; (3) That by means of the operation the duration of the treatment is so very much shortened, reducing to a few months what would otherwise take as many years; (4) And, finally, because by means of it, we greatly reduce the risk of tubercular infection, which results from the absorption of caseating products."

(4) *Value of the Limb.*—This *quæstio vexata* of thirty years ago is now largely settled. Very few will, nowadays, be found to dispute which is most serviceable, a limb, though much shortened, with a natural foot, or an artificial leg, especially of the kind supplied to hospital-patients after amputation of the thigh. On this subject some remarks of Mr. Holmes (*Surg. Dis. of Children*, p. 497) may be quoted: "Even if we allowed that a patient, after successful excision of the knee, could only walk as fast and as far as some with a good artificial limb after amputation, this would still leave the operation of excision, in my mind, far the superior one, since the former patient can do by his own force, without any preparation and without any expense, what the latter can only do by the aid of the instrument-maker. I need hardly say, however, that this is a gross understating of the case. A patient, after excision of the knee, can often walk nearly as fast and nearly as far as he could before. The patient, after amputation of the thigh, however well the

case may have done, can rarely bear the fatigue of carrying the artificial limb many miles together, nor can there be any reasonable comparison of the agility of the two—at least in those cases where the foot, after excision, comes nearly on to the ground, and is in good position." As to those cases where the limb is flail-like and its growth seriously arrested, I would point out that they should hardly ever occur, with the improved treatment of wounds, the greater facilities with which a stiff apparatus of a simple kind can nowadays be supplied, our more exact knowledge of the epiphyses, and the substitutes for the saw which are ready to our hands in the shape of sharp spoons (p. 640). I may also refer my readers to Sir W. Fergusson's Hunterian Lectures, Lecture VI., and his arguments in favour of a much-shortened limb over any artificial one.*

(5) *Condition of the Patient.*—I may refer my readers to the remarks on this point on excision of the hip, p. 594. There is the same need here for examining for any evidence of lardaceous disease, or tubercular mischief, elsewhere, and to remember how latent and insidious these may be. Bone mischief elsewhere is not necessarily prohibitive. Three out of my seventy-seven cases (p. 634) had had spinal disease, well-marked bosses remaining in all. Each of them made an excellent recovery. Strumous disease of the tarsus existed in two others, and was cured by the time the knee was well. In two, disease of the hip co-existed on the same side; in one the limb had eventually to be removed by a Furneaux Jordan's amputation, the child recovering; in the other (the disease being on the opposite side) the knee after a trans-patellar excision did excellently, the hip disease being cured by rest.

(6) *Stage of the Disease.*—I have already shown (p. 635) that I am a strong advocate for early excision in hospital cases, believing that, with the usual treatment, short of this, pulpy disease goes on, as a rule, inveterately from bad to worse. But in early life excellent results may be obtained, even in advanced cases with sinuses and caries, by excision, if only all the diseased and septic material is got away.

It will be useful to some of my readers if, before leaving the subject of tubercular disease, I quote the opinion of one of the first living authorities on excision of the knee, Mr. Howse (*Guy's Hosp. Reports*, 1894): "In answer to the question, '**In what cases should excision be performed?**' we should say: (*a*) Certainly in all cases in which the disease has advanced so far as to cause flaking of the articular cartilage or grating in the movement of the joint, whether suppuration be present or no. (β) Cases in which backward displacement of the tibia has taken place. (γ) All cases of over six months' duration, in which there is reason to believe that the disease has started in an epiphysial osteitis. (δ) Cases of extensive suppuration in the joint starting from pulpy mischief. (ϵ) Cases in which the pulpy infiltration of the synovial membrane has advanced to any considerable degree over the articular cartilage. (ζ) Cases in which pulpy infiltration has extended beyond the capsular ligament to the crucial ligaments and semilunar cartilages." In the first four the condition and the need of excision are alike obvious. If in the last two difficulty of diagnosis arises, the time limit of six months will be found of most value.

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* Mr. H. Lee (*Lancet*, 1888, vol. i. p. 769) published the results, after twenty years, of two cases of excision in boys of twelve and seven. In the first the leg was nine inches, in the second six inches shorter than its fellow. Both patients had perfect use of the muscles of the leg and foot, and could walk all day with a light iron patten attached to a boot. Such shortening is, nowadays, unknown.

The same authority gives (*ibid.*) **the conditions in cases of "pulpy knee" which call for immediate amputation.** They are: A. Constitutional; and B. Local. A. Constitutional. (a) Lardaceous disease. (β) Tubercular disease of the lung or other viscus. (γ) Great emaciation without any very evident visceral disease. (δ) Multiple joint disease (*vide* p. 636). B. Local. (a) Osteitis or periostitis extending far up the shafts of either femur or tibia, as shown by great thickness or tenderness of the bone.* (β) Very great infiltration of pulpy material into the soft parts, extending far beyond the limits of the joint.

(ii) Threatening disorganisation of the knee, with caries, after pyæmia, infective arthritis, etc.

(iii) Osteo-arthritis.—Where one joint only is affected, and the patient is not past middle life, excision gives good results. The surgeon must be prepared for sawing very dense bones.

(iv) Ankylosis.—I think excision should be abandoned here for the far better operation of dividing, with aseptic precautions, the union, with an osteotome introduced first on one side and then on the other, and worked forwards under the patella, and skin, and backwards as far as the popliteal artery allows. If this fail, a double osteotomy of the femur and tibia should be performed rather than excision, an operation which, in the case of true bony ankylosis, is liable to be severe, prolonged, and to leave a large wound, and, in the case of young subjects, to lead to further shortening of a limb already atrophied and weakened from disease. As I shall not have space again to refer to this matter of ankylosis of the knee, I would strongly urge caution in rapidly and completely straightening a knee-joint which has long been the seat of a bony ankylosis in a bad position. My attention was drawn to this matter in a painful way about seven years ago. A girl of 19 had been admitted under my care with bony ankylosis of the knee at a right angle, dating to disease seventeen years before. Finding that I was unable to materially improve the position by subcutaneously sawing through the bony union, I excised the joint and straightened it completely. The foot and leg remaining cold, an anæsthetic was given next day, and the limb put up flexed. The mischief was, however, done. The coldness remained, all pulsation in the tibials stopped, and gangrene evidently threatening, the thigh was amputated, the patient sinking afterwards.†

At the necropsy, osteophytes were found on the posterior border of the tibia projecting backwards, and it was evident that over these, when the limb was straightened, the popliteal vein, a very small one, had been stretched and closed.

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* Mr. Howse points out that, occasionally, tenderness and thickening may be due to a sequestrum, which may be successfully removed, and later on a useful limb obtained by excision.

† Just after this another London surgeon published a very similar case. Sufficient attention has not been drawn to this matter. It would have been much wiser on my part, with such dense and old-standing ankylosis, not to have attempted complete straightening at once, but to have straightened partly with an osteotome at first, and then to have completely rectified the position later. I have adopted this mode successfully since, in a much older patient, with almost as much contraction.

(v) Old, Neglected Infantile Paralysis.—Excision of the knee seems to me to be perfectly justifiable here, with a view of giving a firm support in the case of a limb useless from its flail-like, distorted state. I speak here of hospital cases, which furnish those miserably crippled lives which are still seen from time to time going the round of the hospitals.

I have during recent years been making use of operative measures largely in these cases, following, as far as the principle goes, my old friend, G. A. Wright, of Manchester, and Mr. R. Jones, of Liverpool. Everyone who has seen much of these cases, with their dangling, flail-like limbs, going from hospital to hospital for courses of electricity and medicine, quickly outgrowing or breaking expensive apparatus, obtained at much cost of time and trouble—anyone who has taken the trouble of watching the after-history of these cases, and has realised how often they come, when adolescent, to amputation on account of persistent trophic sores appearing on the useless limb, must have wished that some operative steps could be devised which, at a cost of a few months, might make these early afflicted patients less of an encumbrance to others. The only question is what operation is best adapted to render the flail-like knee and ankle sufficiently firmly fixed to bear their share of the weight of the body. G. A. Wright (*Abstracts of Cases treated in the Pendlebury Hospital*, 1884) records the case of a girl, aged 14, in which he excised the knee and ankle in such a case with good results. Mr. R. Jones (*Prov. Med. Journ.*, Dec. 1894 and Jan. 1895) recommends a modified erasion, opening the joint, peeling off all the cartilage in the case of the ankle, and, in addition, gouging the bone in that of the knee. While I agree with Mr. Jones that excision involves a greater sacrifice than an already shortened limb can spare, I maintain that by itself this operation is insufficient. If we are to do any good with these advanced and confirmed cases of infantile paralysis, we must replace, somehow, the flail-like limb by a useful firm support early in life, before puberty. Now, I have in several cases tried excision or erasion of knee and ankle, and have found that in such a limb the joints do not unite firmly enough; the result, if watched, is, therefore, not sufficiently good. The reason is not far to seek. In early life, if only small sections are removed with the saw—and no more is permissible for fear of further serious interference with the length and growth of the already dwarfed and dwindled limb—the bone surfaces are scant and puny, the rims of cartilage are, relatively, very large. Here the conditions needful for firm union are absent, and I have found excision or erasion alone of the knee and ankle does not entirely remove the flail-like condition of these joints. In two cases I have gone farther, and in addition to excising the knee I have passed Mr. W. A. Lane's screws between the tibia and femur, and after all the cartilage has been removed from the surfaces of the tibia, fibula, and astragalus, have passed stout silver wire between the tibia and astragalus. These cases have been thus operated on about five months. The foreign bodies have, so far, given no trouble, and the stability of the limbs is greatly improved. The time that has elapsed is not sufficient for one to speak confidently, but the result is certainly sufficiently encouraging for me to call the attention of my professional brethren to it.

B. INJURY.—Here such injuries as those from gunshot and those from a lacerated wound or a compound fracture, must be considered separately.

1. Gunshot.—"The results of the excisions of the knee-joint, performed during the late civil war, whether the operations were primary, intermediary, or secondary, were not very encouraging, forty-four of the fifty-four cases in which the issues were ascertained having terminated fatally, a mortality of 81·4 per cent., exceeding the mortality of the amputations of the thigh (53·8) by 27·6 per cent." (Otis, *loc. supra cit.*, p. 419). Sir T. Longmore (*Syst. of Surg.*, vol. i. p. 565) lays down these definite rules: "From all the experience which has been gained regarding gunshot wounds in which the knee-joint has been opened, especially if the surfaces of the bone have escaped damage, as may occasionally happen with modern narrow rifle bullets, and even in other cases where one of the bones has been fissured, or partial fracture has occurred, provided early immobilisation of the injured parts can be secured, antiseptic treatment carried out, and the general surroundings are sufficiently hygienic, it may now be laid down as a rule that conservative treatment ought to be adopted. When, however, the circumstances under which the wounds have been inflicted are such that the precautionary methods and modes of treatment mentioned cannot be put into practice, when the patients are liable to be moved frequently or to long distances hurriedly, and without adequate protection, or when the joint is not only penetrated, but the surrounding coverings are much lacerated, or the bones are comminuted and the fragments completely detached, the sacrifice of the limb by amputation above the joint is the only measure calculated to afford a fair promise of safety of life to the patient."

2. Injuries other than gunshot.—Excision is rarely practicable here. A very careful consideration of the local and general conditions present is needful. Amongst the former, damage limited to the articular surfaces, but little splintering of the shafts of the bones, an intact condition of the softs parts behind the joint are absolutely essential. Not less important is it to weigh the more general points connected with the patient—viz., his age not reckoned by years only, the condition of his viscera, and his habits; all these points are attended to in the account of "The Treatment of Compound Fractures," given later on.

Operation.—Before and throughout an excision of the knee the operator should bear in mind the following points: (1) To remove every atom of the disease; (2) to secure good drainage; (3) to leave the bones in good position; (4) to ensure absolute immobility afterwards; (5) to watch for and at once attack any relapse. The more I perform this operation, the more do I feel the truth of the words of Prof. Bruns, of Tübingen, that, while formerly its chief object was to remove all dead bone, it should now be considered of chief importance to remove all the tuberculous material that can possibly be got away, and that the surgeon should not content himself with snipping away all he can, leaving the rest to caseate or become scar-tissue if it will, but pursue it with the same earnest aim of extermination as he would in the case of malignant disease. I would not by the above seem to speak sli ingly of the value of securing healthy and correctly sawn surfaces of bone, as on these largely depends firm ankylosis and a sound and useful limb, but I would insist on the fact that such surfaces are secured in vain if pulpy material is allowed to remain, and that it is not as yet sufficiently recognised that other instruments—*e.g.*, sharp spoons and scissors curved on the flat—are to the full as useful as the saw.

Mr. Howse takes a different view of the importance of exterminating tubercular material (*loc. supra cit.*): "In thus advising the only partial removal of the pulp, it is necessary to recollect the changes of which it is capable. Many surgeons treat it as if it were a tumour formation, the success of the case depending upon its complete removal or destruction. That is, I am sure, a mistake. Pulpy material in its after-history is susceptible of three changes. (1) It may be simply absorbed, just as any inflammatory material disappears by the process of resolution; (2) it may undergo caseation by the process of starvation in the way already described; or (3) it may organise and become converted into good fibrous tissue." I can only say that with regard to the first and the third of the above, my experience has been much less happy than my colleague's; with the second or caseation we are all, of course, familiar wherever the tubercular material be met with. I repeat that, whether in glands in the neck or in the synovial membrane of joints, it should be treated once for all, if possible, thoroughly, determinately, and with the same earnest aim of extermination as in the case of malignant disease.

Before the time of the excision, any flexion of the knee should be corrected as far as possible by careful weight-extension. A knee should never be excised while flexed. Such a step will only be liable to lead to removing bone needlessly in order to straighten the limb. The risk of gangrene has been already mentioned (p. 637).

The parts having been duly cleansed, and an Esmarch's bandage* applied at mid-thigh, the limb is brought over the edge of the table, flexed, and held by an assistant as in Fig. 259.

From the moment of commencing the operation to its very close the surgeon must bear in mind the inveteracy of tubercular pulpy material (malignancy would probably not be too strong a word), and in his endeavours to extirpate the disease completely, both in the soft parts and in the bones, his operation must often combine the operations of erasion and excision.†

The following modes of exposing the joint will be given here:

A. Transverse, Removing the Patella. **B. Transverse, through**

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* Some object to the bandage as needless and as likely to lead to troublesome oozing after the operation. This may be met by firm pressure and even bandaging on of the dressings, so as to distribute any oozing evenly throughout them. If an Esmarch's bandage is not applied, the bleeding during the operation interferes with the removal of diseased tissues, requires constant pressure to arrest it, and taxes the patient's resources considerably. Its use meets another risk, which is possibly hypothetical, and that is, it renders impossible the general diffusion of tubercular material by the cut veins and lymphatics. Two Esmarch's bandages must not be applied if there is any risk of rupturing a pulpy capsule, or where the capsule has given way and septic sinuses exist.

† If operations for pulpy knee are resorted [illegible] an earlier stage in hospital patients the bones will less and less need interferi[illegible]

the Patella. C. **The Semilunar Flap** (lately recommended by Mr. Barker, and attributed by him to Moreau).

A. **Transverse, Removing the Patella** (Fig. 257). This, the older method, is still resorted to by those surgeons who, like Mr. Howse, believe that, if the patella is retained, a most serious risk is run of leaving behind pulpy material which will require removal later on under less favourable circumstances, and, this failing, may lead to amputation.

The surgeon, standing on the left* side of the diseased knee (the opposite limb being tied to the table) makes an incision right across the joint from the back of one condyle to that of the other.† This incision passes over the lower part of the patella and divides the lateral ligaments at once. The soft parts being then dissected up for two inches above the patella, so as to expose the supra-patellar pouch, deep incisions are made above and below the patella, which is then removed and the joint opened.

Fig. 257.

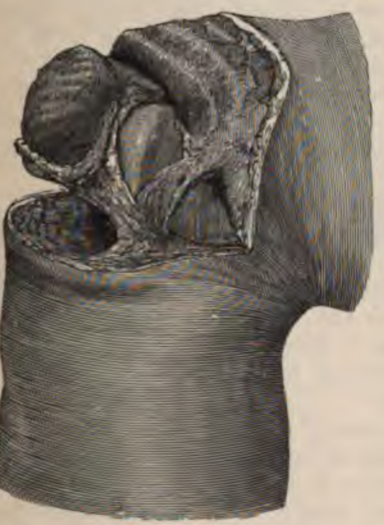
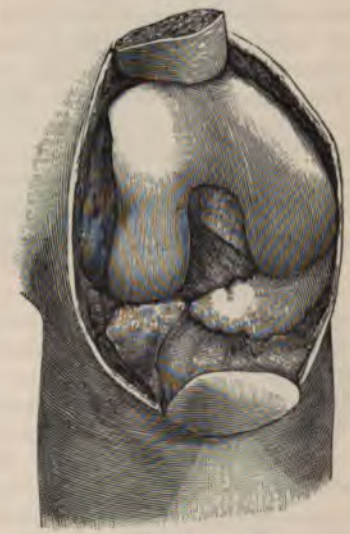


Fig. 258.



Trans-patellar excision.

If the patella is ankylosed to the condyles, it must be removed by a blunt elevator, aided by a narrow saw, or, better, by an osteotome and mallet. No violence should be used in opening a joint partially ankylosed, or the epiphyses may easily be separated from the shaft, especially in a child.

I invariably, when raising the flap of soft parts in an excision of the knee, however performed, slit them up by a vertical incision, going to the upper limit of the supra-patellar pouch, so as to expose fully all its folds and recesses. Unless this is done, pulpy material is very easily left behind, and, later on breaking down, leads to œdema, persistent sinuses, perforation of the pouch and spread of disease amongst the adductors and into the vicinity of the femoral, and perforating vessels where it is impossible to eradicate it, amputation being eventually called for.

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* This position renders it much easier for him to saw the femur and tibia.

† Beyond this spot the incision should not go, for fear of wounding the internal aphena vein. This would lead to troublesome œdema of the foot and leg, and, if the nd should become septic, might bring about septic phlebitis and pyæmia.

B. **Transverse, through the Patella** (Fig. 258).—This method, by preserving the patella and the insertion of the quadriceps, partly counter-balances the flexing action of the hamstrings (p. 648) at the same time. Used by Volkmann many years ago, it was again brought under the notice of English surgeons by Mr. Golding Bird in a case which he brought before the Clinical Society (*Trans.*, vol. xvi. p. 82).

For arguments against preserving the patella I must refer my readers to Mr. Howse's article (*loc. supra cit.*). I am of opinion, myself, that in young subjects where the union is prone to bend for some time, it is well worth while to preserve the patella, though, to insure the full benefit of this step, fresh osseous surfaces should be prepared on this bone and on the femur and tibia so as to promote bony union. Another and minor argument in favour of preserving this bone is that the anastomoses about the joint are less interfered with.

The transverse incision is made here much as in the first method, only across the middle of the patella; this is sawn through or divided with a stout knife, the fragments turned up and down, and the joint freely opened (Fig. 258).

C. **Semilunar Flap** (Moreau, Barker).—Here a large U-shaped flap is raised by a semilunar incision, starting above one condyle, descending to the level of the tibial tubercle, crossing the leg here and running up to a corresponding point on the other side. In raising this flap, which includes all the soft parts down to the bone, either the ligamentum patellæ should be severed (suturing of this being resorted to later), or the tuberosity, attached to the ligament, is removed with a chisel, and subsequently wired down (Barker).

The joint having been opened by one of the above incisions, it is well to slit with a sharp bistoury the supra-patella pouch* up to its upper limits (readily reached by a finger), so as to lay bare every crevice and to remove every atom of diseased tissue. The cut margins being held on the stretch by two Spencer Wells's forceps, the surgeon with mouse-toothed forceps seizes the cut edge of the synovial lining of the capsule, and with curved scissors removes it in one piece, first from under the vasti muscles and then along its reflexion on to the femur down to where it ceases at the margin of articular cartilage.

Next the lateral and crucial ligaments are examined, and every particle of diseased tissue removed, only bright, glistening, clearly healthy ligamentous tissue being left.† But as naked-eye examination in parts perhaps not absolutely bloodless may easily be fallacious, it is much better in doubtful cases to remove these completely than to run any risk whatever. The assistant who is in charge of the limb now brings the head of the tibia well into view by pulling the calf of the leg well forward with one hand while he further dislocates the bone by pushing up the leg (Fig. 259).

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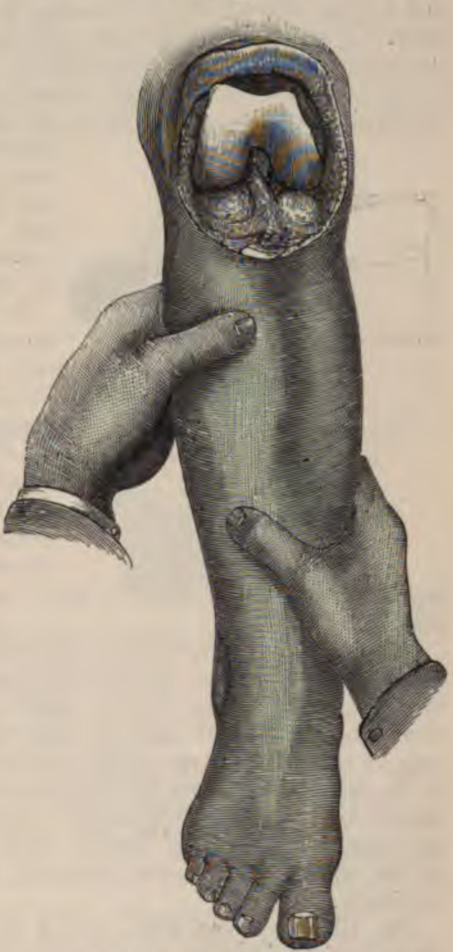
* I look on this as one of the most cardinal points of the operation.

† Prof. Ollier (*loc. infra cit.* and *Rev. de Chir.*, 1882) drew attention to preserving the lateral ligaments, if possible, together with all healthy periosteum and capsule—*i.e.*, those tissues which will keep the bones in place and which will tend to produce ossifying material. This will not interfere, if carefully carried out, with extirpating diseased parts, while it will go far to prevent progressive flexion of the joint.

FIG. 259.



The condition of the semilunar cartilages is next examined, and if they are invaded by pulpy tissue, or if it is intended to perform a complete excision, they must be cut away entirely.

The back of the joint is next taken in hand. This region can be far more effectively dealt with after removal of the bones. If, owing to the case being an early one, with little or no caries, the surgeon desires to remain content with an erasion, he must still deal thoroughly with the posterior ligament* and deeper parts of the sides of the joint with all recesses and folds of the synovial membrane. To expose these parts thoroughly is a matter of some difficulty. The assistant should manipulate the limb as above directed at one time, at another flex the leg back towards the table, while occasionally a finger in the popliteal space will keep within reach any altered tissue that it is desired to deal with. Every pains must be taken to use the scissors systematically and thoroughly here as elsewhere, until healthy tissues are reached, and not to dread the popliteal artery too much. This should be enforced for two reasons. If any diseased tissue is left here, it will be shut in after the limb is extended and be impossible to deal with, save by a fresh and probably unsuccessful operation. Again, there is always a risk, especially in a surgeon's earlier operations, of his not dealing with disease here with sufficient thoroughness from dread of injuring the popliteal artery. This vessel may be avoided by (1) not dipping the points of the scissors deeply, but using the blades as far as possible parallel with the course of the vessel; (2) by remembering that even after the posterior crucial ligament has been thoroughly cleansed (a matter often imperfectly done) there is still a considerable thickness of tissue in front of the artery.

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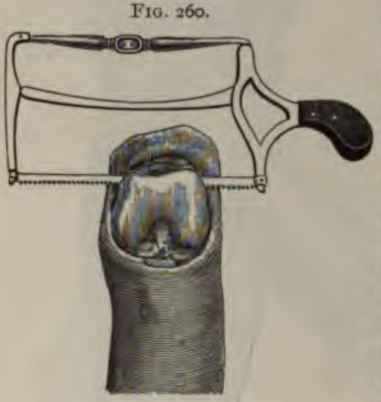
* This and the posterior parts of the semilunar fibro-cartilages are liable to be inefficiently treated.

After all diseased tissues at the back have been thoroughly eradicated, the deeper aspects of the sides of the joint must be examined. In one case I was unable to satisfy myself that the limits of the diseased tissues were reached till the tendons of the semi-tendinosus and semi-membranosus came into view; and in another, that of the sartorius, caseating foci having spread down beneath the fascia on the inner side of the joint. If an erasion is thought sufficient, the surgeon, having gone over the synovial membrane systematically and in detail, now attends to the bones. With a stout, sharp scalpel, he scrapes or pares off from the cartilaginous surfaces of femur and tibia any adherent pulpy material, removing thin shavings of the cartilage where needful. This must be carried out to the very back of the condyles and throughout the intercondyloid notch, and around the posterior aspect of the head of the tibia.

FIG. 260.



It now remains to describe the removal of the bones in case erasion is not sufficient. Thus, excision will in future be probably called for only in cases of long standing, where caries is present, and in those with sinuses and suppuration. Where excision is evidently needed, the bones should be sawn after the supra-patellar pouch is cleared out, and before the posterior aspect of the joint is taken in hand, as this step will be much facilitated thereby.

The femur, held as steady as possible, is taken first. A groove for the saw is first so marked out with the scalpel as to remove about one-third of the condyles. In severer cases, or where the above section will clearly be insufficient, half, or even two-thirds, of the articular surface may be removed, but no section should be made farther back than this, or the epiphysis will be trenched upon with serious after-results.* Care should be taken, in making the section of the femur, to ensure that the plane of the sawn surface shall be at right angles to the axis of the shaft. Mr. Howse prefers to saw the femur while this is held vertically.

The tibia is taken next, and a groove marked out with the knife about half an inch below the articular cartilage. A Butcher's saw, set horizontally, is used from behind forwards, and on a perfectly level plane. Neither here nor in sawing the femur must the slightest wobbling of the saw be permitted.

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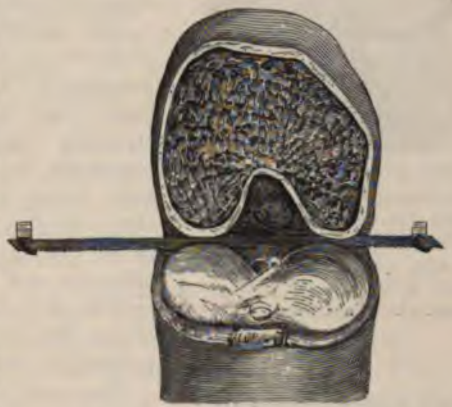
* Dr. Hoffa, of Wurzburg (*Arch. f. klin. Chir.*, Band xxii. Heft 4, 1885; *Annals of Surgery*, March 1886), brings forward cases to show that removal of both epiphyses led, at the end of ten years, to shortening, amounting to 25½ cm. (1 cm. = $\frac{4}{10}$ inch), while in another case it amounted in two years to 10 cm. Loss of the femoral epiphysis alone showed 17 cm. of shortening in six years, and 7 cm. in a year and a half. Two cases of the like duration affecting the tibial line showed respectively 15½ and 6 cm. It is, however, well known that considerable shortening may occur in cases treated expectantly. Dr. Hoffa found in one case with ankylosis at an angle that at the end of twelve years the shortening amounted to 18 cm.; in nine other such cases, ranging in duration from one to eight years, the shortening varied from 1 to 13½ cm., with angular contraction in most cases, and with very marked atrophy and trophic disturbances.

About half an inch only of the tibia should be removed, just enough in fact to expose healthy cancellous tissue, and no more. Of the femur, no more than an inch and a half should be removed if possible.* Any soft, yellow, cheesy, fatty patches, any cancellous tissue into which pulpy tissue has dipped after perforating the cartilage, should be carefully removed with a gouge. Where, however, there is much caries or the above patches are numerous, breaking down readily under the finger-nail, more than one slice of bone had better be removed.

The whole wound is now finally most carefully scrutinised, every outlying angle and recess being examined for pulpy tissue left behind.

FIG. 261.



The Esmarch's bandage is now by some removed, and, while sterile pads wrung out of hot 1 in 2000 hydr. perch. are held firmly over the sawn tibia, any bleeding points in the upper half of the wound are attended to. The safest way of arresting the bleeding is by underrunning with chromic gut and fine needles all the vessels which spirt, as practised by Mr. Howse; or Mr. Barker's plan (*vide infra*), which I greatly prefer, may be tried. Bleeding from the cancellous tissue will be arrested by placing the bones in contact.† If there is any tendency of the edges of the skin to fold in, these must be shortened.

The best means of arresting the hæmorrhage, and one which I have followed in all my later cases of excision and erasion, is that advised by Mr. Barker (Hunt. Lect., *supra cit.*). The Esmarch's bandage is here not removed until the dressings—a thick layer of iodoform gauze, salalembroth or salicylic wool, or wood wool—are firmly bandaged in position. To admit of sufficient pressure being applied to check the oozing and to distribute it evenly through the dressings, a white bandage should first be applied from the foot to the upper third of the leg. If one of Mr. Howse's splints is employed, the Esmarch's bandage must be applied sufficiently high up the thigh not to interfere with the limb being placed in the splint, as this has to be done before the dressings are applied. I have found this plan most satisfactory.

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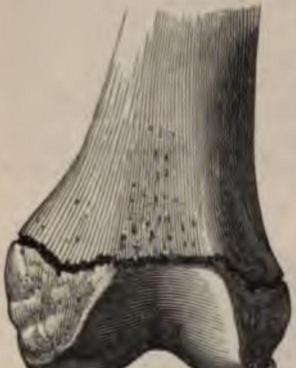
* Very much larger amounts may be removed if needful, especially in children and young adults, with good reparative power. If the surgeon is obliged to trench upon the epiphyses it should be with the gouge, and not with the saw, if possible. In one case of a boy, aged 7, the bones being carious, soft, and fatty, a large patch of cheesy, fatty bone presented itself in the head of the tibia after the first slice had been removed. On removing this, the gouge entered the medullary canal, which was exposed, gaping on the sawn surface. I was doubtful how far union would take place here, but three years later the boy had a most useful limb, probably from a ring of epiphysial tissue being left.

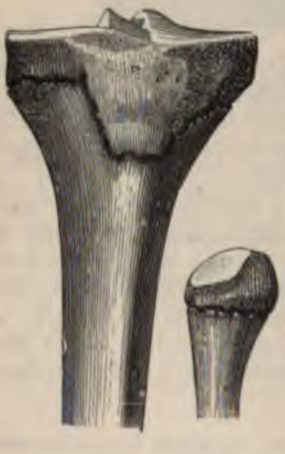
† The following vessels will be found to give the chief trouble after a combined erasion and excision: One or two running down in the periosteum over the femur, one or two in the cut periosteum surrounding the sawn margin of the tibia, and one from the azygos articular in the posterior ligament.

FIG. 262.



This and the next figure shows the line of the epiphyses which enter into the knee-joint, seen from the front. That of the fibula is also seen. They are taken from a well-grown subject of about 18. (Farabeuf.)

FIG. 263.



The patella, if sawn, is now drilled and wired, or united with stout silk or chromic gut. I prefer the first, the wire being left long and removed in about a fortnight.

The question now arises whether the tibia and femur should be united by wiring or pegging.* I am of opinion that if the bones have been so sawn as to bring their faces squarely together, with sufficiently exact closeness to prevent more than a finger-nail being inserted between them, and if they are put up with the security which is given by Mr. Howse's method, the above aids are not needed.† Failure of excision is due not to deficiency of repair in the bones, but, as a rule, to persistency of pulpy, tubercular material.

The need of drainage must vary with the experience of the operator. If the bone surfaces are well together, if the angles of the wound are left open, and if aseptic precautions have been taken throughout, drainage is rarely required. Two or three sutures may be made use of in the middle of the incision, the sides being always left open. Before closing the wound, I rub a little sterilised iodoform over the different surfaces, and dry these scrupulously, when the sutures are in place. Mr. Howse's splint is now applied. To those who are not familiar with the most excellent method devised by my colleague, the following brief account‡ may be useful. The arrangement will be found most simple, and equally efficient in admitting of antiseptic dressing and maintaining the parts in absolute rest. The splint consists of two interrupted tinned-iron troughs for the thigh and leg joined by a posterior bar. This is from four to six inches long, according to the age of the patient; it is convex from side to side to avoid cutting into the popliteal space, and can be lengthened or shortened if any alterations in the interruption are required. At the end of the splint is an adjustable foot-piece.

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* The bones have been united with different forms of pegs or nails, or by wire, stout carbolised silk, or chromic gut.

† I may be speaking with insufficient knowledge, but I am under a strong impression that the advocates of these aids have not made trial of the absolute fixity ensured by a well-applied Howse's splint (*vide infra*). Mr. Morrant Baker's and Mr. Howard Marsh's methods of fixing the bones by steel or bone pins will be found in the *Brit. Med. Journ.*, 1887, vol. i. pp. 321, 389.

‡ *Guy' Hosp. Reports* 1877, vol. xxii. p. 503, and the accompanying plate.

The limb being laid in the splint, attention must be paid to the posterior bar being in the centre of the popliteal space, the foot must be well down on the foot-piece; if the splint grips the thigh or leg too tightly or rides too loosely, it must be bent out or in with iron "crows." The dressings are now applied, preferably those of iodoform gauze, wrung out of carbolic-acid lotion, and wool. Great care must be taken to bandage from below upwards and from within outwards, the bandage being laid on evenly and firmly so as to distribute the discharges, evenly, right through the dressings, and to prevent their coming through at one or two spots. The splint is next secured to the limb with "waxed bandages," prepared by passing them through a mixture of ordinary yellow wax and olive oil, in proportions sufficient to make the wax soft and workable. After they are applied to the leg and thigh they are painted over with a little hot wax mixture, so as to make them weld into one mass.* The limb, thus secured, is slung with cord and pulley to Howse's modification of Salter's cradle. This occupies the lower part of the bed; the patient lies on a half water-bed.

The chief points now are (1) to ensure as absolute immobility as possible; (2) to employ as infrequent† dressings as practicable; (3) to watch for every sign of relapse, and to attack it as soon as noticed.‡

After-treatment.—Morphia or laudanum should be used freely at first, if needful. If the temperature keep down, the dressings should be left undisturbed for two weeks, when an anæsthetic may be given, if needful, to remove the wire if the excision has been a trans-patellar one, take out any drainage-tubes, and also to make sure that there are no persistent sinuses pointing to a residual pulpy material. These, if found, must be slit up with a sharp-pointed curved bistoury, and scraped out with a sharp spoon. While this may be repeated every two weeks, on five or six occasions successfully, the more deliberately the surgeon endeavours to extirpate the disease both in the soft parts and in the bones, the more he treats it as if malignant at first, the less often will he have to interfere later on.

In about three months, Mr. Howse's splint may be left off and a leather splint fitted on, carrying a metal bar to resist the tendency to flexion. Some such fixed apparatus should be worn, in children, for three or more years.

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* The splint is usually lined with lint wrung out of the above mixture. But the popliteal bar and any of the splint close to the wound must be metal only, uncovered, to prevent sepsis. If any spaces are found to exist between the limb and the splint they may be filled in with cotton-wool, soaked in some of the hot wax mixture.

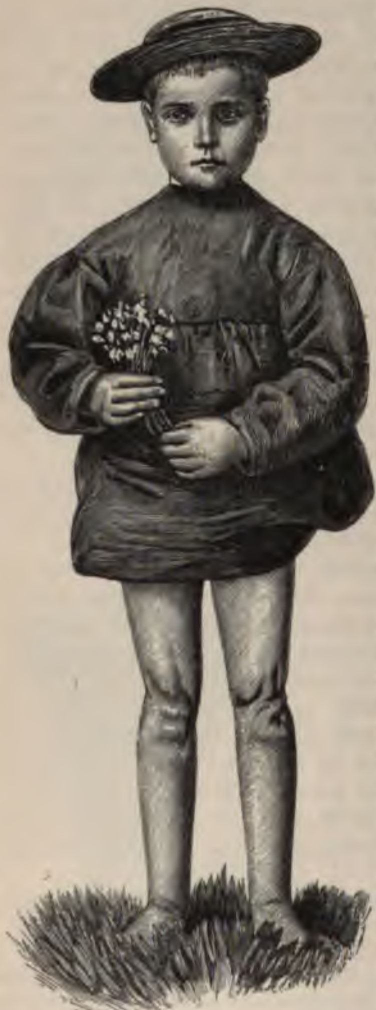
† Infrequency of dressings has been strongly insisted on by Prof. Ollier (*Rev. de Chir.*, Aug. 1887; *Annals of Surgery*, Nov. 1887, p. 424). This most important economy—of pain to the patient, and time to the surgeon—is only to be secured by—(1) Removing every atom of the disease that can be got at. (2) Providing drainage. The more thoroughly the disease is extirpated, the less need is there to drain; but however completely the disease is removed, many sutures should not be employed, especially at the ends of the wound. (3) Securing as dry a wound as possible.

‡ It is especially, I think, from neglect of this last detail, that the fact arises that almost as many cases are lost from mistakes in the after-treatment as from want of skill in the operation.

In early life callus-like material is thrown out quickly, and often somewhat irregularly, between the bones, but it is extremely slow in really ossifying. As the quadriceps extensor wastes much more quickly than the hamstrings, even when the patella is retained, the latter muscles keep up their action on the tibia for months, and even for years, until the union is firm. Tenotomy has been advised, and even resection of all the hamstring tendons (Dr. Phelps, *New York Med. Record*, July 21, 1886; *Annals of Surgery*, October 1886, p. 364). I think, however, that retaining the bones immobile and in good position, securing early healing of the wound, wearing a stiff apparatus, and, wherever practicable, using the trans-patellar method, will best ensure a limb soundly ankylosed in good position. A knee bent later on can be easily straightened.

Causes of Failure and Death after Excision of the Knee.—1. Inveterate persistence of pulpy material leading to (*a*) giving way of the supra-patellar pouch, and the results mentioned at p. 642; (β) to formation of caseating foci, especially at the back of the joint (p. 643), and only to be removed by re-excision or amputation. (2) An unhealthy condition of the bone ends, with caries and chronic osteo-myelitis. 3. Deficient reparative power, leading to bed-sores, emaciation, irritative fever, hectic. 4. Co-existence or subsequent development of such visceral diseases as phthisis, &c. 5. Surgical scarlet fever. 6. Septic Conditions.—For these the surgeon will, nowadays, be, as a rule, entirely to blame. 7. Tetanus. 8. Secondary Hæmorrhage.—Another very rare condition. 9. Fat Embolism.—This is a still rarer condition, but one, which, on account of the interest it excited some years ago, and because it has once, at least, proved fatal, deserves mention here.

FIG. 264.



A case of excision of both knees, two years after the operation, from a patient under my care at the Hospital for Children and Women, sent to me by Dr. A. T. F. Brown, of Rochester. Both knees were the subject of tubercular disease on admission. One was excised three months after the other.

The case was that of a child, aged 12, submitted to excision for pulpy disease by Vogt, of Griefswald (*Cent. f. Chir.*, 1883, p. 24). The bones were so fatty as to cut with a knife. Though but little chloroform had been given, and the loss of blood had been slight, the patient died twenty-four hours later with shallow respirations, feeble pulse, and low temperature. Fat embolism of the lungs, extensively diffused was found post mortem. Vogt considered that this case predisposed to fat embolism. Thus cut vessels were exposed on the sawn surfaces with plenty of free oily matter close by, and unable to escape, owing to the bone-ends being in close contact (two wire sutures were used). A similar case, after hip resection, by Prof. Lücke, is mentioned. Prof. Vogt thought that he would amputate in another case if, after excision of the knee, the limb could not be straightened without close apposition of the sawn fatty bone-ends.

10. Shock.—This, though rare, must be remembered. Seventeen years ago I lost a case from this cause.

The patient was a delicate boy, aged 7, with a large pulpy knee. As there was no suppuration, no sinuses, nor evidence of much mischief in the bones, I, unwisely as it was proved, tried to save the limb. The child sank a few hours afterwards. Volkmann (*Cent. f. Chir.*, Bd. xii, Heft 9, Feb. 28, 1885; *Ann. of Surg.*, May 1885, p. 486) draws attention to the need of taking care in children that too much blood is not lost, and that deep narcosis is not too prolonged.

ERASION* OF THE KNEE-JOINT.

Definition.—By this operation, which we owe to G. A. Wright,† of Manchester, is meant a systematic removal of the synovial membrane, which is, here, so often pulpy. If the ligaments are diseased, they are also removed; but if the bones and cartilage be involved, it must be only to a slight degree, so that all the disease can be got away by paring with a knife, or scraping out with a sharp spoon. Where sections of the bone have to be made, the operation becomes an excision as well as an erasion.

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* Arthrectomy was a term introduced by Volkmann (*Cent. f. Chir.*, 1888), it is less accurate, and, etymologically, comes too near to excision.

† *Lancet*, 1881, vol. ii. p. 992; *Med. Chron.*, July 1885. See also a paper by Mr. Shield (*Ann. of Surg.*, Feb. 1888), and one by Mr. E. Owen (*Med.-Chir. Trans.*, vol. lxxii. p. 56). The following are Mr. Wright's conclusions: "In those that have done well the common factors appear to be: (1) absence or very small amount of suppuration; (2) superficial or, at least, not wide-spread bone disease; (3) absence of general tuberculosis. In short, fairly early disease in a not hopelessly tuberculous child. This pretty well corresponds to the cases generally considered suitable for excision. I have not yet tried the operation in adults. It is clear that extensive disease of bone and much suppuration will not allow good results to be obtained by erasion; neither, as a general rule, will they by excision, though I am quite sure that the knee may be successfully excised in cases where erasion is out of the question, as shown by excision succeeding where erasion has failed. Although in one case a freely movable joint resulted, I do not advise the attempt to obtain mobility by early passive movement, except in a few instances where the wound has healed at once, and there is no obstacle in the way such as dense and lowly vitalised cicatricial tissue. Erasion, if it fails, leaves the limb little, if at all, in worse condition for excision afterwards. In those cases where amputation became necessary, either the local or constitutional condition forbade hope of successful excision. Where it succeeds, erasion leaves as sound a limb as excision, without shortening. In some cases there may be mobility, though I think in most it will be found that there is not enough mobility to be useful; here the limb is very liable to become flexed after healing of the wound, but the same is true of excision in children. I think, then, that in suitable cases erasion is, in disease of the knee, better surgery than excision, but its application is strictly limited. In all cases I have employed strictly Listerian antiseptics."

Value of Erasion as compared with Excision; Suitable and Unsuitable Cases.—Where a knee-joint, the site of pulpy trouble, resists, in hospital patients, non-operative treatment continued for three or four months; where there is no evidence of caseation in the joint (very difficult to tell, but indicated by chronic obstinacy of the disease, by spots where the feel is distinctly doughy or becoming bluish in tint)—in other words, where the disease is early, but, owing to the patient's surroundings, will go on from bad to worse, erasion is preferable to excision. Its *advantages* are, (1) There is no removal of bone-slices, and, still less, any interference with the epiphyses. Thus, there is no shortening and no arrest of growth. This latter advantage will be at once recognised, when it is remembered that (p. 594) the increase in length of the femur takes place chiefly at the junction of its shaft with the lower epiphysis, and in the case of the tibia at its upper epiphysis. In one of my cases, a girl of 11, there was not only no shortening, but repeated careful measurements showed half an inch increase of length, perhaps due to the increase of vascularity after the operation, about the above-mentioned epiphyses. (2) With regard to the retention of mobility, the frequency with which this has been obtained and its advantage have been, in my opinion, much exaggerated. I have no doubt whatever that a larger number of carefully published cases will show that where movement is sought for, the risk is run of a certain degree of permanent flexion, of attacks of pain and swelling, and of the formation of troublesome sinuses. I should strongly dissuade from any attempt to secure mobility in the case of the knee and ankle. (3) The ligaments are less interfered with, and thus, the ties of the joint being preserved, firm union is more speedy. (4) If performed early, erasion, like excision, cuts short the disease, and thus gives a considerable saving of time in children, at an age when every month is of great importance. (5) It is better suited to young children. Thus, as it does not arrest development, it may be used very early. Wright has operated "with perfect success in a child under two years of age."

The *disadvantage* of erasion—I am speaking only from an experience of eighteen cases—is, I think, chiefly this, that if the operation fail, excision is rendered much more difficult. I cannot here at all agree with the statement of my old friend, the chief authority on this subject, that erasion, if it fail, leaves the limb little, if at all, in worse condition for excision afterwards. This is true of the limb, but not of the joint. In one of my erasions which required excision, I found that the previous operation had entirely obliterated the usual landmarks, and that great difficulty was experienced and much care needed in dealing with such parts as the remains of the posterior ligament.

The *cases suitable for erasion* are those where the disease is limited, or almost limited, to the synovial membrane, with little, if any, caseation; where the cartilage and bones are almost intact, where there are no abscesses or sinuses, where there is no evidence of other tubercular disease, and where the power of repair is satisfactory.

Operation.—The preliminaries are the same as for excision (p. 640). A trans-patellar incision (Fig. 258, p. 641) should be employed. But to ensure thorough exposure of the supra-patellar region, a very dangerous area on account of its numerous nooks and crannies which give lurking-places to pulpy mischief, I always slit this pouch right up to its very top with a sharp-pointed bistoury, thus dividing the upper flap into two. G. A. Wright ensures the same end by making "longitudinal incisions through the tissues on each side of both halves of the patella, upwards as far as the upper limit of the synovial pouch, and downwards nearly to the tubercle of the patella." The flaps being then, one by one, thoroughly everted with a sharp hook, taking the upper half of the joint first, I seize the tip of one of the flaps with mouse-tooth forceps, and then, with blunt-pointed scissors curved on the flat, dissect the diseased synovial membrane off the under surface of the split quadriceps expansion in a continuous strip till the uppermost limit of the supra-patellar pouch is reached. The reflection of the synovial membrane over the front of the femur is then dealt with in the same way, leaving the periosteum on this quite clean. The joint being then well bent, and the tibia being brought forward as directed (p. 643, Fig. 259), the crucial ligaments, the semilunar cartilages, the inter-condyloid notch, and the synovial reflections behind the crucial ligaments are carefully inspected. To do this thoroughly, it is absolutely needful to divide the lateral ligaments sufficiently. With regard to the other structures, some retain the semilunar cartilages, if healthy, others remove them in any case. For my part, as it is so essential to remove *all* the synovial membrane, and this is impossible unless the semilunar cartilages go, I always remove them. With regard to the crucial ligaments, the anterior nearly always requires removal; as regards the posterior, the whole ligament, or as much of it as possible, should be left, since its removal is extremely liable to be followed by backward displacement of the tibia. The inter-condyloid notch, and the reflection behind the crucial ligaments, is then taken in hand, very wide flexion of the joint, and a finger of an assistant in the popliteal space, here facilitating this, the most difficult and important part of the operation. When much disease is present here in the synovial membrane, both crucial ligaments must be unhesitatingly divided, and, if needful, the overhanging posterior part of the condyles must be cut away. In dealing with the synovial membrane in the inter-condyloid notch, the surgeon must remember that he will never have a similar chance of dealing with the disease here, and that, if any is left behind, excision, and perhaps amputation, will be called for. The synovial membrane around the lower half of the patella is then removed, and finally the ends of the bones are examined. Any pits and foci are gouged out, and more extensive ulceration shaved off with a strong sharp knife. Drainage, if needful (p. 646), is then provided by making counter-punctures with a Lister's sinus-forceps in the popliteal space, on each side of the limb. The dressings are applied with the same precautions given at p. 647, and not until all is completed is the Esmarch's bandage removed. Throughout the operation irrigation with lot. hydr. perch., 1 in 3000, should be diligently employed.

The after-treatment is the same as after excision (p. 647), as there is the same tendency for a long while for the limb to become flexed, there is the same urgent need for a rigid apparatus for several years.

Causes of Failure after Erasion.—These are chiefly: (1) Some of the [illegible]s left behind. This is known by a persistent sinus, and the liability of the limb to become puffy, hot, and tender. (2) Inability of the patient to repair the wound which is left. (3) Failure of the surgeon to maintain asepsis.

WIRING FRACTURES OF PATELLA.

This operation, brought before the profession by Lord Lister in 1883, seems to have dropped somewhat out of notice. This is chiefly due to two facts: (*a*) Many surgeons consider that the results of non-operative treatment are satisfactory. Dr. Powers (*Ann. of Surg.*, July 1898, p. 67) records the opinions of ninety surgeons on the subject. Seventeen of these, or over 23 per cent., are deliberately opposed to the operation, nine urge operation in all cases, while forty-one, or over 56 per cent., recommend operation only in certain cases. (*b*) In spite of the vastly-increased familiarity with antiseptic methods, much of the old dread of opening the knee-joint still survives. And there is no doubt that infection of the joint does occur occasionally even in the hands of well-known careful surgeons. In a total of 711 operation cases collected by Dr. Powers (*loc. supra cit.*) there were three deaths from sepsis, and probably there were other cases in which suppuration occurred, for in the total of 711 cases there were two in which total ankylosis took place, and twenty-eight others in which "marked stiffness and disability" resulted. Although these cases form a comparatively small proportion, nevertheless they have to be reckoned with when putting the question of operation before the patient and his friends, and have to be balanced against the longer period of treatment necessary, and the disability due to bad union if non-operative treatment is carried out.

In the remaining 671 cases collected by Dr. Powers, or in 94 per cent., the result was "satisfactory," so that the operation may be considered to be fully justified under certain conditions. The **indications** may be stated thus:—

1. In Lord Lister's words (*loc. supra cit.*), "no man is justified in performing such an operation, unless he can say with a clear conscience that he considers himself morally certain of avoiding the entrance of any septic mischief into the wound."

2. Certain Cases of Old Fracture of the Patella.—This important matter must be taken somewhat in detail. The chief points here justifying resort to wiring are: (*a*) Failure of previous treatment, especially in hospital patients. (*b*) A useless limb, especially in a man whose occupation entails much walking or standing, where the gait is helpless and requires much attention, or where many falls have followed involving serious risk of fracture on the opposite side. (*c*) Where both patellæ are fractured. (*d*) Where the patient is young and has many years of active life before him. (*e*) Where, if not young, the patient is sufficiently healthy. (*f*) Where enough is known of the patient's habits to ensure his being amenable.

3. Recent Fractures.—These must be considered separately, according as they are (*a*) simple; or (*b*) compound. In the former case the general opinion of the profession has appeared to be against operation, owing to the good result which usually follows on non-operative

measures. Lord Lister's * five cases of wiring in recent fractures prove how safe this method is in skilled hands. (*b*) In compound fractures the matter seems to me to be different. Here a wound already exists, and, if the patient's condition is good, no harm can be done by wiring, with antiseptic precautions, any fragments which happen to be widely separated. Furthermore, such a step may be easily combined with the needful examination and irrigation of the joint with dilute solution of mercury perchloride or carbolic acid.†

Operation.—The parts being thoroughly cleansed, an incision is made, with the strictest antiseptic precautions, about three and a half inches long, either vertically or transversely. The former is adopted by Lord Lister. The latter is more convenient, and admits more readily of getting at the lateral aspects of the joint, if the aponeurosis above requires division at these points.‡ It is said to have the disadvantage of being more likely to give way and expose the joint if a refracture should take place later. I used it in four out of the five cases mentioned below, and think it well to make it rather above or below the interval between the fragments, so that this and the wound shall not lie opposite to each other.§ The fragments when exposed ‖ are generally found embedded in fibrous tissue, thickened synovial membrane, and old decolorised coagulum. This must be snipped or cut away, and any spirting vessels in the thickened synovial membrane must be secured. In old cases a very thin section from each fragment is then removed with a narrow-bladed saw, this needing much caution in the case of the lower one, which is the smaller of the two. If the fragments can now be pressed into close apposition, nothing remains save to wire them, but the case is by no means so simple where the bones are widely apart.

Thus, in one of my cases, after paring the fragments—these were quite two and a half inches from each other—and after most forcible traction the upper could only be made to descend three-quarters of an inch. Malgaigne's hooks were applied and tightly screwed up, but with no result on the desired approximation. The lateral expansions of the quadriceps were next still more fully divided (cut muscular fibres being seen on the inner side), but the fragments were almost as far apart as ever. As the only alternative to excising the joint (in order to substitute a firm support for the flail-like limb), I now divided partially the rectus tendon, but it was not till the upper fragment was only held by a narrow stout band at its upper and inner parts that it could be brought in apposition with the lower one. The result was excellent.

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* Lord Lister goes so far as to consider (*Lancet*, Nov. 3, 1883) that "the ununited case is in every respect worse as a subject of operation than the recent." This is chiefly owing to the wasting of the fragments and their greater separation. Again, in recent cases, there is no need to pare the fragments, for after sponging away of clots the surfaces are ready for coaptation.

† Dr. G. R. Fowler, of New York (*Ann. of Surg.* Sept. 1885, p. 248), calls attention to the great importance of making these cases aseptic at the first. In his case the bone was split up into three fragments. The two lower ones were first wired together, and their upper margins were next sutured to the upper fragment by two wire sutures, one for each lower fragment.

‡ It would also be probably more convenient in a compound fracture.

§ An Esmarch's bandage is not needed, and would have the objections of causing oozing afterwards into the joint-cavity, and also of preventing that bringing down of the extensors of the thigh which may be required in cases of wide separation.

‖ In one case, the skin being dimpled, puckered down, and adherent between the fragments, I had to cut away a piece about three-quarters of an inch wide.

In these difficult cases it must be remembered that it is not absolutely necessary to get the fragments into exact apposition. If, after wiring, they come within a quarter of an inch of each other, the limb will be a most useful one, though of course exact apposition is to be desired.* When, in spite of all the above, approximation of the fragments is still impossible—though it is difficult to imagine such a contingency—the knee should be excised either now or on another occasion, so as to give a firm support.

The fragments being sufficiently approximated, they are now drilled. This may be easily effected by an ordinary bradawl, sterilised. The bones should be drilled obliquely, the instrument entering each fragment a full half inch from the fracture on the upper surface, and emerging above the cartilaginous surface below.† Where the lower fragment is too small to hold a wire, this may be passed through the ligamentum patellæ, as has been done by Lord Lister (*loc. supra cit.*) and Mr. Teale (*Brit. Med. Journ.*, June 9, 1883). One wire would appear to be sufficient: though this unites the centre of the fragments exactly, a very slight interval remains at the edges, but does not interfere with an excellent result.

When the wire is twisted, two half-twists, or one complete one, will be sufficient, and it should be noted at the time in which direction the twist is made, in case the wire is removed. This raises the question as to **the best way of dealing with the wire,** whether to cut it short and embed the ends by gently hammering them into the fibrous tissue over the upper fragment, or to leave the wire long enough to admit of its being removed later. I have alluded to this question at p. 631. Lord Lister advocates the former course. I shall not, I trust, be thought wanting in proper respect if I suggest that in the knee, at least in women who have much kneeling, removal of the wire will be more satisfactory. Thus, in one of my cases, in which I had hammered down the wire, the woman returned, nearly a year later, to have the wire removed. She had not been able to kneel, the suture could be felt, and at one spot the skin was ulcerating over it. I ought to state that the patient was a very thin one, and that I had made three or four half-twists instead of two.‡

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* In a case of Mr. Wheelhouse's (*Brit. Med. Journ.*, June 9, 1883) the fragments, originally an inch and a half apart, could only be brought within half an inch of each other: an excellent limb resulted.

† While it is well to take this last precaution, it probably does not matter much (supposing, of course, that strict antiseptic precautions are taken) if the wire is passed within the joint. Lord Lister gives the following aid to making the two drill-holes exactly correspond: "Supposing that on one side the instrument should have come too far down, it may be into the cartilage, we do not regard that at first, but pass the wire through the two drill-holes, and then on that side on which the hole has come too far down, by means of the bradawl we simply chip away a little of the material that is above the wire, until the wire comes to be in a position exactly opposite to the hole on the other side." If, in another case, there is a difficulty in making the drill emerge upon the fractured surface, Lord Lister would advise the withdrawal of the drill and substitution of the blunt end of a needle, and then with a gouge or bradawl an opening is excavated upon the fractured surface, opposite to the other drill-hole, until the needle is exposed; the wire can then be easily passed.

‡ Prof. Macewen (*loc. infra cit.*) mentions a case which came under observation three months after suture of the patella, with acute suppurative arthritis of the joint

Before the wire is twisted or hammered down, if this course is decided upon, the surgeon must decide as to **drainage** of the joint. When the operation has been difficult, involving much separation of adhesions and interference with the parts, drainage should be employed through the wound to the most dependent part of the joint at the outer side (Lister), thrusting the instrument here through the joint and soft parts, cutting upon it and drawing a drain through. The wound is then united and dressed. As soon as the deeper part of the wound is healed, every pains must be taken, by massage, &c., to improve the atrophy of the quadriceps. Healing should be complete in three weeks. If it be decided to remove the wire, this may be done six or eight weeks after the operation, by making a small incision through the scar. The number of half-twists and the direction in which they have been made must be recollected at this time. The wire is first untwisted and straightened, one is next cut off short, and the other grasped in dressing-forceps, and wound round the tips of these. It is then extracted without jerking.

The **question of passive movement** now arises. Usually, about six or eight weeks after the operation, the patient may get up and begin to use the limb (with the aid of two sticks at first), flexion and extension being diligently practised. Unless the joint is very stiff, massage, friction, and gentle persevering movement, aided by time and patience, will be sufficient. If an anæsthetic is given, movements must be made cautiously, as the patella has been refractured on this occasion more than once.*

Difficulties in Wiring the Patella.

1. Atrophied surfaces of the fragments, making it difficult to refresh them satisfactorily. 2. A very small lower fragment. 3. Fragments embedded in very firm fibrous tissue, fascial, periosteal, and synovial, or old coagulum. This condition will prevent satisfactory apposition unless the intervening tissue be all removed. In a very interesting case recorded by Mr. O. Ward (*Lancet*, Nov. 1, 1884) it was found, on exploring the fragments, that the capsular tissues torn off the lower fragment remained attached above, and hung like a flap between the fractured surfaces, effectually preventing their apposition. It is suggested that some such complication may, in many cases which have been treated in the usual way, cause the fragments to fall apart as time

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and ulceration of the cartilage. A probe passed through a sinus detected the wire surrounded by carious bone. The twist was still intact, but the loop was loose, the bone having become inflamed, softened, and ulcerated. Excision of the joint was required. This shows that, occasionally, the wire may excite irritation, and thus lead to serious results. Mr. Turner (*Lancet*, 1887, vol. i. p. 572) records a case in which Mr. M. Robson, of Leeds, had wired an ununited fracture of the patella, three gold wires being employed. The patient, an epileptic, probably injured the knee repeatedly, the wires worked out, and the knee-joint became acutely inflamed, requiring free incisions and drainage.

* In one of Lord Lister's cases (*loc. supra cit.*), passive movement being employed with "considerable force" four weeks after the wiring, the rigid quadriceps not yielding, the wire gave way, and the cicatrix (a long longitudinal one), which had healed save where the wire projected, opened. The joint was at once washed out antiseptically, and, six days later, some coagula were removed and the old wire re-twisted. An excellent limb was the result.

goes on. This is supported by Prof. Macewen (*Lancet*, Nov. 17, 1883; *Ann. of Surg.*, March 1887, p. 178), who has collected thirteen cases of transverse fracture of the patella, in which portions of soft tissue intervened between the fragments in such a manner as to render osseous union an impossibility. 4. A contracted, rigid quadriceps. 5. In-dipping skin, p. 653. 6. Multiple fragments.—This may cause much difficulty, especially if it is the lower and usually smaller fragment which is comminuted. If the lower fragment is large enough to bear wiring, a smaller one may be removed; or the wire may be passed through the ligamentum patellæ. If a case seemed to require it I should not hesitate to wire smaller fragments with finer wire, and to pass one stout one from the highest to the lowest fragment (or ligamentum patellæ), this wire lying in the joint, and passing under and over one of the smaller ones. To give a firm support excision could be resorted to as a last resort, either at the time or later.

Causes of Failure.—These are, mainly: 1. Inability to bring the fragments together.—Mr. Turner (*Clin. Soc. Trans.*, vol. xviii. p. 41) mentions a case in which the operation was abandoned, as it was found impossible to get the fragments together after wiring them. The patient was "no better and no worse" eventually. 2. Septic conditions. 3. Necrosis of a fragment.—This is a complication rather than a cause of failure. It is especially likely to occur after severe compound fractures, in which the periosteum was much injured at the time of the accident. This happened with the upper fragment in Dr. G. R. Fowler's case already quoted. About three months after the wiring, this fragment, about the size of a walnut, was removed. It was now found that "the joint was perfectly closed by a thick fibrous capsule underlying the necrosed portion, connected to the upper margins of the now firmly united two lower fragments, and forming a strong bond of union between the quadriceps above and what remained of the patella below." The resulting limb was useful, with considerable movement at the knee-joint.

REMOVAL OF LOOSE BODIES* FROM THE KNEE-JOINT.

This is another instance of an operation rendered safe and simple by the antiseptic treatment of Lord Lister. Removal by **direct incision** will therefore be alone described here.

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[*] The following classification may be useful to a surgeon about to operate for one of these bodies: (1) A thickened or indurated synovial fringe which has become pedunculated and perhaps detached; (2) a fibro-enchondroma originating in those cartilage cells which are naturally found in the synovial fringes; (3) a portion of articular cartilage detached by injury (four years ago I removed one of these loose bodies from the knee-joint of a railway porter who came to me for synovitis, with the history that the attacks dated from the time when a cask which he was moving had slipped and struck the inner side of his right knee-joint—*Lancet*, 1889, vol. ii. p. 363); (4) a bit of cartilage may, after injury, gradually become detached by a process of quiet necrosis (Paget); (5) blood effused into a synovial fringe; (6) mass of fibrine; (7) a detached osteophyte; (8) Mr. H. Marsh (*Dis. of Joints*, p. 182) mentions a case of Mr. Shaw's, in which a loose body on removal was found to contain the point of a needle.

Operation.—The parts having been kept at rest for some days before and scrupulously cleansed, the foreign body is found,* if possible, and retained in a superficial part of the capsule. If it be very movable, it should be harpooned with a sterilised needle at the beginning of the operation. The joint is then deliberately and sufficiently opened. In the traumatic case I have mentioned, the body could not be felt at the time of the operation; on cutting freely into the joint I came down on a tiny pedunculated body attached to the deformed internal condyle; as this was evidently too small to be the offending body, I had, after removing it, to make a prolonged search with the finger before the loose cartilage was found at the extreme upper end of the supra-patellar pouch. In any such case where the body can be felt, but not brought down, a second incision should be made over it. All bleeding is now finally arrested, and the wound closed by two layers of sutures, of which the deeper takes up the capsule. If the operation has been a simple one, no drainage will be required, effusion being prevented by aseptic precautions and firm, even bandaging. Where the search has been prolonged, the parts much interfered with, or many bodies removed, a horsehair drain or a small tube must be passed through the wound and a counter-puncture made at the most dependent part of the joint.

Iodoform having been dusted on, the usual dressings are applied, and the limb put up on a back splint.

INTERNAL DERANGEMENTS OF THE KNEE. SLIPPED FIBRO-CARTILAGE.†

These affections are so crippling and vexatious that I shall allude to them here, though operative interference will be rarely required if the case is treated by the proper apparatus (*vide infra*). The key-note to the satisfactory recognition of these injuries and their well-doing is a recognition of the fact that one of the semilunar cartilages, usually the internal, may after a hurt or wrench of the joint be partially torn away from its marginal attachments, usually the anterior ones (Annandale). In some cases the cartilage is split instead of displaced; in others it undergoes gradual enlargement in consequence of repeated injury and synovial irritation. With regard to treatment, it should be distinctly understood that, after reduction, rest, counter-irritation, &c., the application of ordinary splints or knee-caps is not of the very slightest use; there is one instrument, and, as far as I know, one only, which will meet these cases, and do away in the great majority of them

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* The patient is often clever at this. Mr. H. Marsh (*loc. supra cit.*) suggests that it may save disappointment if fixing the body has been practised beforehand by the assistant to whom this office is to be entrusted. In those rare cases where the body cannot be found, no surgeon familiar with antiseptic details would hesitate to freely cut into the joint if the history and the crippling of the patient justified this. In other cases, as occasionally happens in lithotomy, the body is known to be present, but cannot be felt when the patient is on the table.

† Reference should be made on this subject to the following writings:—Hey, *Pract. Observ. in Surg.*, 1803; Howard Marsh, *Dis. of the Joints*, p. 190; Annandale, *Brit. Med. Journ.*, 1887, vol. i. p. 319; H. W. Allingham, *ibid.*, 1888, vol. i. p. 1110, and *Treatment of Internal Derangements of Knee-Joint by Operation.*

with any need of operation, and that is the "
Spratt, Hawksley, &c., and figured by Mr. H.
account of this affection (*Dis. of the Joints*, p
watched the use of these clamps in many patie
strongly to their value.

Operation.—Where the above clamps fail, or
present, as in Prof. Annandale's and my cases;
by the affection, and other conditions are satisfac
and removal or, much more rarely, suture of the
The skin having been carefully cleansed, and
precautions made use of, an incision, longitudin
tioned below—a transverse gives more room but
joint more—is made over the fibro-cartilage, f
All bleeding having been carefully arrested, the
incised, and hæmorrhage again stopped. The co
is then investigated, and, if displaced, it is draw
blunt hook, and removed or sutured[*] with fine
and fascia over the edge of the head of the tibia.
be thus brought into position, it should be re
should be done if a portion is found split off bu
growth that is present, whether fibro-fatty of th
or an osteo-arthritic outgrowth from the bone (
removed by scissors, saw, &c. If drainage is c
few strands of horsehair are inserted, and the sy
carefully brought together with buried sutures
incision is then closed with sutures. In abo
movements of the joint should be begun. Th
after-treatment is obstinate stiffness, which is,
come in course of time.

The following are brief notes of one of the few
found it needful to remove a semilunar fibro
noticed that previous treatment had failed, and t
present to a marked degree in a young patient :–

R. C., aged 35, had had repeated displacement of his
wrench of his knee when 17 years old. A clamp gave grea
latterly this ceased to be any safeguard. In April 1894, I
vertical incision three inches long, placed about an inch fr
patella, and beginning opposite its centre. The first thing
joint was opened was the inner condyle with its margin
everted and raised and covered with a network of many m
the tibia, as far as seen, presented the same appearance al
internal fibro-cartilage was found detached from its con

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[*] This step can rarely be advisable. It is difficult to
sutures. Mr. M. Moullin (*Lancet*, 1895, vol. i. p. 1233) me
the displacement recurred after suture. In his words: "Su
make it stronger than it was before it was hurt, unless th
pletely rigid; and if it gave way before, it will give way a
time if exposed to a similar strain."

[†] In very rare cases, with the history and symptoms c
the menisci are found *in situ*, and the only abnormality and
the movements of the joint is a small mass of fibro-fatty
cartilage at the site of pain (Annandale, *Brit. Med. Journ.*,

carried up with the femur. It was thin, flaccid, and limp, flattened out, its circumferential border having lost its thickness and convexity. No bleeding followed on snipping through its posterior attachments. The "lipping" of the cartilage on the femur and tibia was rounded off with a metacarpal saw, some sessile growths of the synovial membrane were snipped away, and two small osteophytes removed from the articular surface of the patella. The inner aspect of the joint was carefully dried out with aseptic sponges, and, as much oozing was expected from the sawn surfaces, a drainage-tube was passed into the upper cul-de-sac and brought out through the wound. The wound healed quickly; a month later the patient could walk across Hyde Park, but it was not till nearly six months after the operation that flexion and extension were completely restored, and the patient could say that there was "not much to choose between the two knees." I saw him two years after the operation; he could then use the lower limbs with equal freedom, and the movements of the left knee were quite smooth. He was able to walk, ride, and shoot with entire comfort.

Another case which had been watched after the operation, before being reported, was brought by Mr. Lockwood before the Clinical Society (*Trans.*, vol. xxvii. p. 133; *Lancet*, 1894, vol. i. p. 673). Here twenty-one months had elapsed since the operation. The left knee had, after an injury, been liable to become locked under circumstances which rendered the patient's occupation, that of an engineer, dangerous. Though nothing could be felt externally, when the joint was opened the internal fibro-cartilage was found to have its anterior third torn up from the tibia. This portion was cut away, and the remainder sewn down to the tibia with silk sutures. The patient made a rapid recovery, but neglecting the advice given, not to play tennis or football for a year, had synovitis with considerable effusion after taking violent exercise. Later on, he reported that for walking, riding, and swimming the knee was as good as the other. Exercises involving any risk of twisting the joint he had avoided.

The following case operated upon by one of us—F. J. Steward—also well illustrates the benefit of operation in certain severe cases:

The patient—a student—had suffered for over seven years from repeated displacement, latterly brought about by quite trivial movements, such as stepping off a kerb. The operation was performed in August, 1900; the cartilage, which had been completely torn from its anterior attachments, being removed. At the present time, January, 1902, the patient is playing football regularly, and does not notice the slightest difference between his two knees.

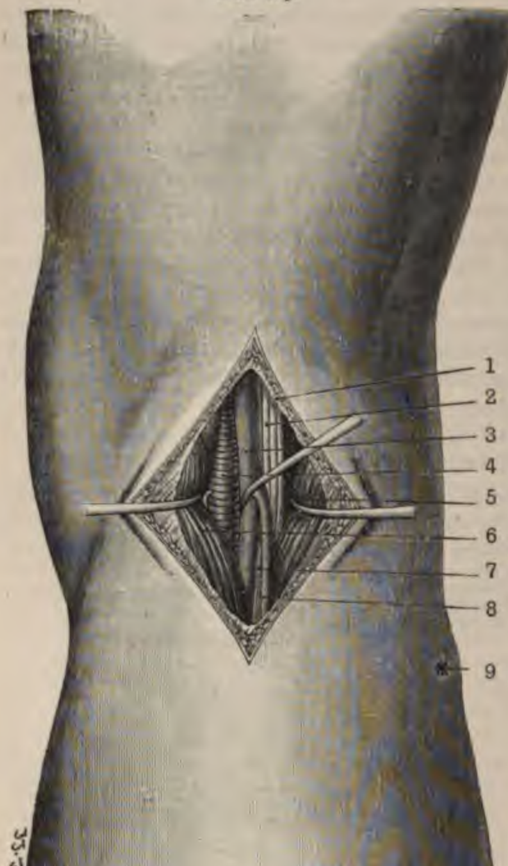
CHAPTER V.

OPERATIONS ON THE POPLITEAL SPACE.

LIGATURE OF THE POPLITEAL ARTERY.

Indications.—Extremely few. i. Stab or punctured wound.—Here the surgeon would only resort to ligature, (1) if pressure was unavailing; (2) if the patient insisted on running the risk of gangrene; (3) it would be well, if possible, to get leave for immediate amputation if the vein was found injured also. ii. In some cases of ruptured popliteal artery it will be right to explore and see if any other complication exists beyond the rupture of the artery.* If there is no injury to the vein, nerves, or the joint (a very unlikely contingency), the rupture may be treated by double ligatures as elsewhere. The surgeon must afterwards be prepared to amputate through the lower third of the thigh on the first sign of gangrene appearing. The operation of ligature of the popliteal artery is extremely difficult here, owing to the depth of the vessel, the strong fascia, the amount of coagulated blood, and the infiltrated, obscured condition of the parts. Primary amputation will, as a rule, be required in cases of ruptured popliteal artery,

Fig. 265.



Ligature of the popliteal artery. 1, Deep fascia. 2, Internal popliteal nerve. 3, Popliteal vein. 4, Popliteal artery. 5, Outer head of gastrocnemius. 6, Inner head of gastrocnemius. 7, Communicans tibialis. 8, External saphenous vein. 9, Head of fibula. (Kocher.)

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* Poland, *Guy's Hosp. Reports*, third series, vol. vi. p. 294.

especially where skilled assistance and facilities for antiseptic treatment are not at hand. A free incision will enable the surgeon to investigate the amount of injury, and at the same time will relieve tension if an attempt be made to save the limb. This incision may form part of the amputation (p. 633). iii. The artery has been wounded in the course of an osteotomy of the lower end of the femur. In such a case the vessel should be reached by the incision shown in Fig. 266. iv. "Possibly in a small traumatic aneurysm" (Sir W. Mac Cormac, *Ligature of Arteries*, p. 109). If any surgeon is inclined to perform the old operation for a ruptured popliteal aneurysm, he should first consult a clinical lecture on a case of this kind by Mr. Holmes. The difficulties which may be expected are graphically described, and the wisdom of amputation shown.

EXTENT.—From the opening in the adductor magnus to the lower border of the popliteus.

GUIDES.—*Behind:* A line drawn from just inside the inner hamstrings above to the centre of the lower part of the popliteal space. *In front:* The tendon of the adductor magnus.

RELATIONS (in the popliteal space):

BEHIND.

Skin; fasciæ; small sciatic nerve, above; short saphena vein and external saphena nerve, below; fat; glands.
Semi-membranosus, above; gastrocnemius, plantaris, soleus, below.
Internal popliteal nerve; popliteal vein, outside above, inside below, exactly over the artery in the centre of the space.
Branch of obdurator above.

OUTSIDE.		INSIDE.
Biceps, above; gastrocnemius and plantaris, below.		Semi-membranosus, above; gastrocnemius, below.
	Popliteal artery.	

IN FRONT.

Femur.
Posterior ligament.
Popliteus.

Collateral Circulation.

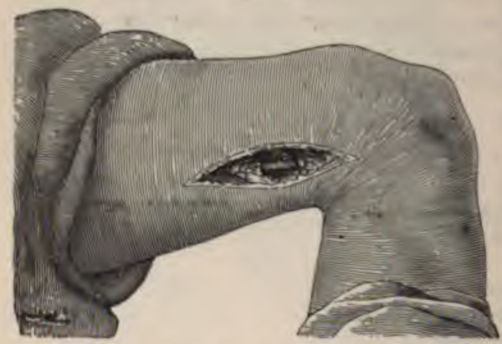
ABOVE.		BELOW.
Anastomotica magna, superior articular, descending branch of external circumflex.	with	Inferior articular, and recurrent from anterior tibial.

Operations (Figs. 265, 266).—The artery may be tied in three places. A. At the upper part of the popliteal space. B. At the lower part of the popliteal space. C. *From the front*, at the inner side of the limb. For the sake of experience, all should be practised on the dead body.

A. **At the Upper Part of the Popliteal Space.**—The patient being rolled two-thirds on to his face, and the limb at first extended, an incision three inches and a half long is made, in the line of the vessel, along the outer margin of the semi-membranosus, and then downwards and outwards to the centre of the space. The small sciatic nerve, if seen, should be drawn to one side; the deep fascia is then freely opened up, and the pulsation of the artery felt for at the outer margin of the semi-membranosus. The nerve is generally seen first, and this and the vein are to be drawn to the outer side with blunt hooks. The needle should be passed from the vein. A good deal of loose fat is usually in close contact with the vessels, and is liable to be a source of trouble wherever the artery is ligatured, especially in the dead subject.

B. **At the Lower Part of the Popliteal Space** (Fig. 265).—The limb being in the same position, an incision three inches and a half long is made, in the line of the artery, from the centre of the popliteal space to the junction of the upper and middle thirds of the back of the leg. The external saphena vein and its nerve being avoided, the deep fascia is freely opened and the limb flexed. The exact interval between the heads of the gastrocnemius is next sought for. The following structures may now be met with overlying the artery, and must be drawn aside—viz., the plantaris, the sural arteries which run down on the vessel, and the communicans tibialis nerve. The popliteal vein now lies to the inner side, together with the popliteal nerve, which is superficial to it, if this has not given off its branches. These structures should be drawn to either side, and the needle passed as is convenient.

Fig. 256.



The artery lies embedded in fat. Above it are some of the fibres of the adductor magnus. In the upper angle of the wound the sartorius has been drawn down.

C. **From the Front, at the Inner Side** (Fig. 266).—This operation might be useful in cases where hæmorrhage recurs after osteotomy at the lower end of the femur (p. 661).

The following account is taken from Sir Wm. Mac Cormac (*Ligature of Arteries*, p. 110): "Flex the knee and place the limb on the outer side. Make an incision three inches long immediately behind and parallel to the tendon of the adductor magnus downwards from the junction of the middle and lower thirds of the thigh. Divide the skin, superficial and deep fasciæ, avoid the long saphenous nerve, seek the tendon of the adductor magnus, draw it forwards and the hamstring tendons backwards. The artery will then be found surrounded by fatty areolar tissue. The nerve and vein do not necessarily come into view, being on the external aspect of the vessel."

CHAPTER VI.

OPERATIONS ON THE LEG.

LIGATURE OF POSTERIOR TIBIAL ARTERY.—LIGATURE OF ANTERIOR TIBIAL ARTERY.—LIGATURE OF PERONÆAL ARTERY.—AMPUTATION OF LEG.—OPERATION FOR NECROSIS.—TREATMENT OF COMPOUND FRACTURE.—OPERATION FOR SIMPLE FRACTURE.—EXCISION OF VARICOSE VEINS.

LIGATURE OF THE POSTERIOR TIBIAL ARTERY.

Indications.—Very rare. i. Chiefly Wounds.—Mr. Cripps,* in a very valuable paper, divides up the sources of hæmorrhage from the upper two-thirds of the posterior tibial into (1) hæmorrhage after amputation; (2) hæmorrhage from injury to the vessels in continuity. (1) Hæmorrhage after Amputation.—This is usually due to a diseased condition of the vessels, and to the fact that the vessels lying between the bones are now especially difficult to take up. If from their constantly breaking away it is found impossible to deal with them, the limb should at once be amputated above the knee. If the hæmorrhage occurs later on, well-adjusted pressure (p. 617) should be carefully tried, aided or followed by ligature of the femoral or by amputation higher up. (2) Hæmorrhage from Wounds of the Tibials in Continuity.—Three chief causes may lead to this: (*a*) An incised wound. (*b*) A punctured wound. (*c*) Wounds other than punctured or incised. Four methods of treatment are open to the surgeon—viz., (*a*) Pressure and bandaging. (*b*) Ligature of both ends of the vessel. (*c*) Ligature of the femoral. (*d*) Amputation. (*a*) *Incised Wound.*—If this is seen soon after its infliction, the bleeding point should be sought for and tied, the wound being enlarged if needful. If sloughing and extravasation of blood have taken place, amputation will probably be the wiser course, though, if the patient decide to run the risk, an attempt may be made to save his limb by making free incisions, providing drainage, plugging the wound (rendered, as far as may be, aseptic with irrigation and iodoform) with aseptic gauze, bandaging evenly and firmly, and tying the femoral in Hunter's canal. (*b*) *Punctured Wound.*—If this is deep, and the vessel injured uncertain, the question of treatment is a very serious one.* Mr. Cripps shows that, in the majority of instances, pressure deserves a fair and thorough trial. If it is useless, or prejudicial to other treatment, either the femoral must be tied or the wound enlarged to secure the wounded vessel. Between these operations the features of

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* *St. Barthol. Hosp. Reports*, vol., xi. p. 94; *Dict. of Surg.*, vol. ii. p. 626.

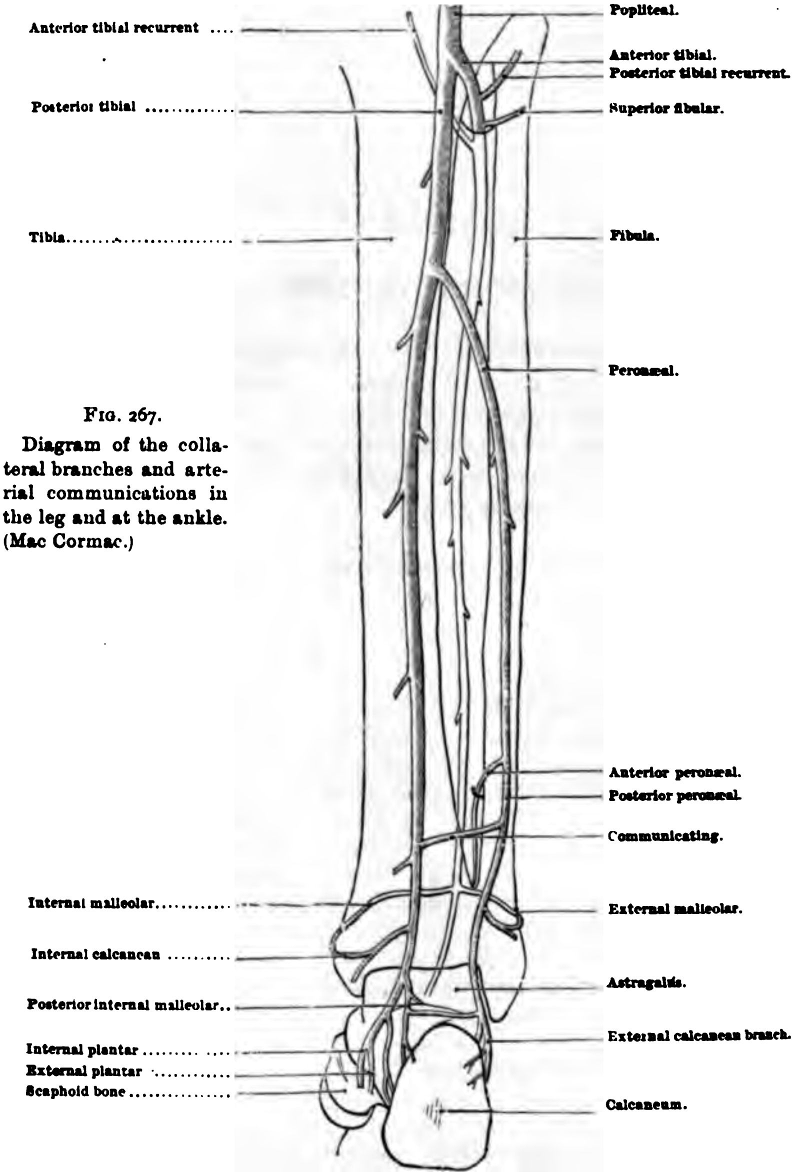

Fig. 267.

Diagram of the collateral branches and arterial communications in the leg and at the ankle. (Mac Cormac.)

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* Where the wound has passed obliquely, Dupuytren's words should be remembered. They refer to hæmorrhage from the calf caused by a pistol-bullet. "Should a ligature be placed on the ends of the divided vessel? But what were those vessels? Was it the anterior or posterior tibial, or the peronæal or the popliteal? Was it several of them at the same time? Should they be attacked before or behind?"

the particular case must decide. If pressure is made use of, it should be applied methodically and with intelligent purpose (p. 617), and so that it needs no alteration or repetition. (*c*) *Wounds other than Punctured or Incised—viz., Injury to the Vessel from Fracture or Gunshot Wound.*—In many cases conditions will be present which will call for amputation—viz., the severity of the crush; the extent of the comminution; injury to the nerves or to both arteries, as evidenced by the condition of the foot; and the age or the health of the patient. In most of these cases, as an attempt to find the vessel involves great difficulty and danger, and the probabilities of success diminish as the interval between the infliction and treatment of the injury increases, ligature of the femoral would be less hazardous than any interference with the wound. But amputation will frequently be needed. The above remarks apply to compound fractures; an instance of successful ligature of a lacerated femoral co-existing with a simple fracture of the leg is given at p. 613. ii. Small traumatic aneurysms. iii. The posterior tibial may be tied low down, together with the dorsalis pedis, for certain wounds of the sole or for some vascular growths of the foot.

LINE AND GUIDE.—A line drawn from a point at the lower part of the centre of the popliteal space* to one midway between the tendo-Achillis and the internal malleolus.

RELATIONS.—These differ according as the vessel is tied—(A) in the middle of the leg, (B) in the lower third of the leg, (C) at the inner ankle.

A. *Relations in the Middle of the Leg:*

SUPERFICIAL.

Skin; fasciæ; branches of saphenæ veins and nerves.
Gastrocnemius; soleus; plantaris.
Special fascia; transverse branches of venæ comites; tendinous origin—arch—of soleus (above).

OUTSIDE.		INSIDE.
Vena comes.		Vena comes.
Posterior tibial nerve which has crossed above from the inner side.	Posterior tibial.	Posterior tibial nerve (above).

BENEATH.

Flexor longus digitorum.
Tibialis posticus.

B. *Relations in Lower Third of Leg:*

SUPERFICIAL.

Skin; fasciæ; superficial veins and nerves.

OUTSIDE.		INSIDE.
Vena comes.		Vena comes.
Posterior tibial nerve.	Posterior tibial.	
Tendo-Achillis.		

BENEATH.

Flexor longus digitorum.
Tibia.

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* This point, representing the lower border of the popliteus, would be about two inches and a half below the knee-joint.

C. *Relations at Inner Ankle:*

SUPERFICIAL.

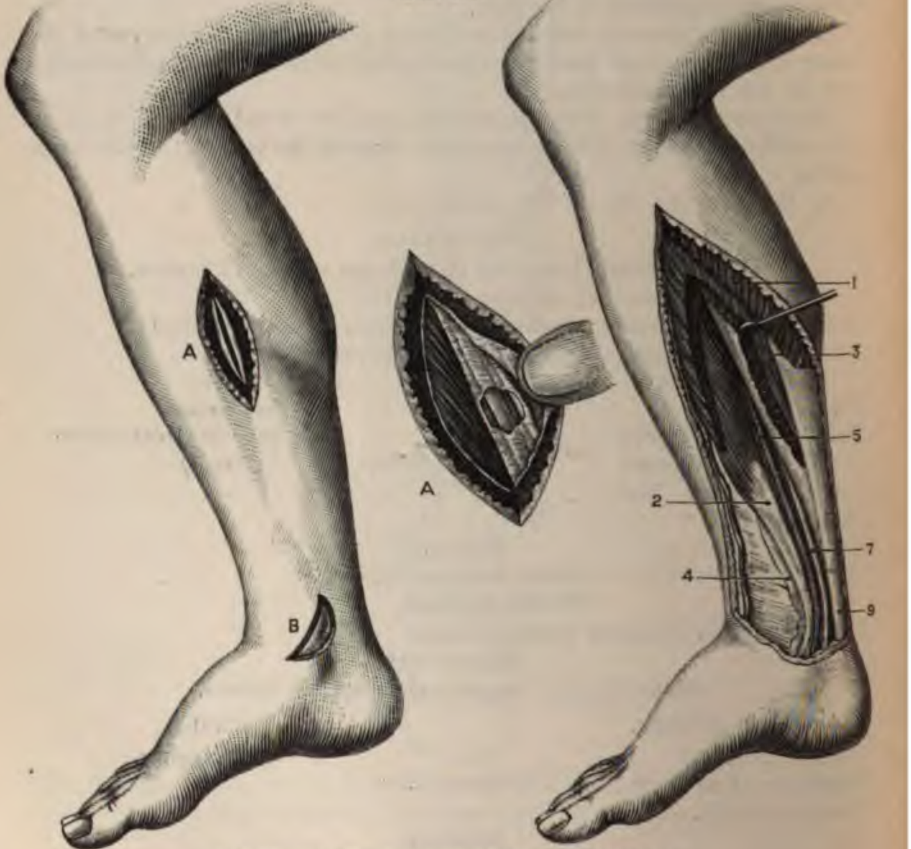
Skin; fasciæ; branches of internal saphena vein and nerve.
Internal annular ligament.

OUTSIDE.		INSIDE.
Vena comes. Flexor longus pollicis. Posterior tibial nerve.	Posterior tibial.	Vena comes. Flexor longus digitorum; tibialis posticus.

BENEATH.

Internal lateral ligament.

FIG. 268.



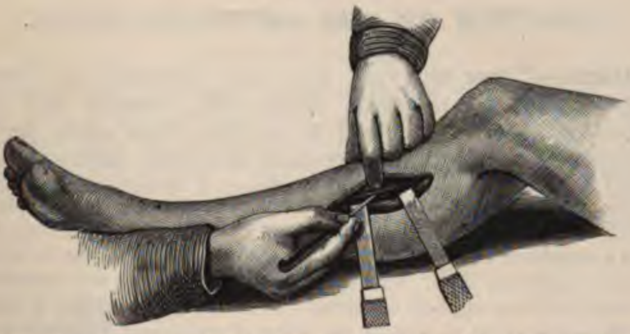
Ligature of the posterior tibial artery. (Heath.)

A, Incision for ligature of the artery in the leg.
B, Incision for ligature of the artery at the inner ankle.
1, Gastrocnemius. 2, Flexor longus digitorum. 3, Soleus. 4, Tibialis posticus.
5, Posterior tibial artery. 7, Posterior tibial nerve. 9, Tendo-Achillis.

Operation in Middle of Leg (Figs. 268 and 269).

The parts having been cleansed, the knee flexed, and the limb supported on its outer side, the surgeon, standing or sitting on the inner side, makes an incision three and a half inches long, parallel with the centre of the inner border of the tibia, and half or three-quarters of an inch behind it according to the size of the limb. This incision divides skin and fasciæ. If the internal saphenous vein is met with, it must be drawn aside with a strabismus-hook; any of its branches may be divided between two ligatures. The deep fascia is then freely slit up, and the inner edge of the gastrocnemius defined and drawn backwards. This will expose the soleus, the tibial attachment of which is to be cut through, any sural artery being at once secured. The incision through the soleus (Fig. 269) should be three inches long and quite half an inch from the tibia; as the fibres are divided, the central membranous tendon will come into view, and must not be confused with the special deep fascia or intermuscular septum over the deep flexors. Usually, before this comes into view, some additional fibres have to be divided. When this is done, the above special fascia must be identified, stretching between the bones. The wound must be carefully dried, well opened out with retractors, and exposed with a good light at this stage. The deep fascia being opened carefully, the nerve usually comes into view first, the artery lying a little deeper and more external. The venæ comites should be separated as far as possible, but rather than puncture them and cause hæmorrhage at this stage, or waste time, the surgeon should tie them in. The needle should be passed from the nerve. To facilitate this, the knee should be well flexed, and the foot also flexed downwards so as to relax the muscles thoroughly. The ligature will lie below the peronæal artery.

FIG. 269.



Ligature of the posterior tibial at the middle of the calf. The inner head of the gastrocnemius is drawn backwards by retractors. The left index raises the anterior lip of the wound while the soleus is divided perpendicularly to its surface. (Farabeuf.)

Operation in Lower Third of Leg.—The limb and the operator being in the same position as before, an incision two and a half inches long is made through skin and fasciæ, parallel with the inner border of the tibia, and midway between it and the tendo-Achillis; after the deep fascia has been opened, another layer, tying down the deep flexor tendons, will require division. The artery here lies between the flexor longus digitorum and pollicis, surrounded by venæ comites. The needle should be passed from the nerve, which lies to the outer side. If the incision is made too high, some of the lowest fibres of the soleus will require detaching from the tibia; if too low, the internal annular ligament would be opened. The sheaths of the flexors (their synovial investment commences about an inch and a half above the internal malleolus) should not be interfered with.

Operations at the Inner Ankle (Fig. 268).—The limb and operator being placed as before, a curved incision, two inches long, is made, three-quarters of an inch behind the internal malleolus. Skin and fasciæ being divided, any branches of the internal saphena vein tied, the internal annular ligament is divided, and the artery found closely surrounded by its veins. The nerve lies externally, and the needle should be passed from it. The artery is so superficial here that the veins can be easily separated. The nerve has occasionally bifurcated higher up.

LIGATURE OF THE ANTERIOR TIBIAL.

Indications.—These are very few, and resemble so closely those already given for the posterior tibial—viz., wounds and traumatic aneurysm—that there is no need to go into them again here.

In the course of 1887, I had occasion to tie the anterior tibial in its lower third for profuse hæmorrhage from a compound fracture, not arrested by pressure.

There was a compound comminuted fracture of the right leg, in the lower third, from a fall of 4 cwt. upon the limb. The upper end of the artery was found with some difficulty, owing to the pulped-up condition of the soft parts. Having failed to find the lower end, I was about to expose the dorsalis pedis, and, trusting to antiseptic precautions, trace this up to the anterior tibial, when, an urgent strangulated hernia being admitted, I plugged the wound, all the undermined parts being previously laid freely open. No recurrence of bleeding took place, and the man (aged 44) made an excellent recovery, aided by his temperate life and patient ways, the freedom with which the wound was laid open (this preventing all retention of discharges), the use of dry gauze dressings only changed at rare intervals, and, not least, the fact that iodoform was thoroughly dusted in.

Dr. Shepherd, of Montreal (*Ann. of Surg.*, No. 1, p. 7), gives another, but more difficult, case in which the compound fracture was about the junction of the middle with the upper third of the leg.

The bleeding was first arrested by pressure. On the fourth day a traumatic aneurysm appeared. The artery was exposed with difficulty,* and found partly divided; two ligatures were applied, and the patient made a good recovery.

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* Dr. Shepherd points out that, the injury to the vessel being just in front of the place where it pierces the interosseous membrane, if the artery had been completely torn through it would have retracted through the opening, and ligature would have been impossible. Mr. F. Page (*Lancet*, 1887, vol. i. p. 522) gives a case of traumatic aneurysm of ten weeks' duration, after a stab, at the junction of the middle and lower thirds of the leg. The swelling had been poulticed and opened, with the result of hæmorrhage. Mr. Page, on clearing out the clots and opening up the swelling, was unable to find the anterior tibial artery. Hæmorrhage recurring, the leg was amputated. The patient recovered.

LINE AND GUIDE.—From a point midway between the head of the fibula and the outer tuberosity of the tibia to the centre of the front of the ankle-joint. The outer edge of the tibialis anticus.

RELATIONS:

SUPERFICIAL.

Skin; fasciæ: cutaneous branches of saphenous veins and nerves, and (below) musculo-cutaneous nerve.
Tibialis anticus and extensor longus digitorum (above), overlapping.
Tibialis anticus and extensor longus pollicis (below), overlapping.

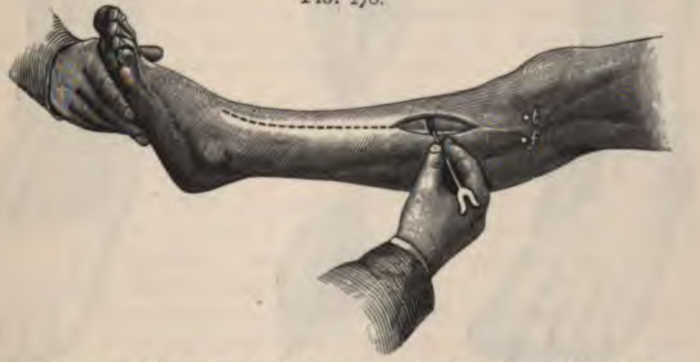
OUTSIDE.	Anterior tibial artery.	INSIDE.
Extensor longus digitorum (above).		Tibialis anticus.
Extensor longus pollicis (below).		Vein.
Anterior tibial nerve.		
Vein.		

BENEATH.

Interosseous membrane.

Operation at the Junction of the Upper and Middle Thirds of Leg (Figs. 270, 271).—The knee being flexed and the limb supported upon its inner side, the surgeon having defined, if possible, the outer edge of the tibialis anticus,* sits or stands on the outer side of the patient, and makes an incision about four inches long in the line of the artery, beginning about two inches below the head of the tibia. This incision should lie (if the edge of the muscle has not been marked out) three-quarters to one inch—according to the size of the leg—from the crest of the tibia, and should expose the deep fascia carefully, so that the white line which marks the desired intermuscular septum may be looked for. This line is often whitish-yellow, and varies much in distinctness. If there is any difficulty in finding it, any bleeding points must

FIG. 270.



Ligature of the anterior tibial artery at the junction of the middle and upper thirds; division of the deep fascia on a director (p. 671). (Farabeuf.)

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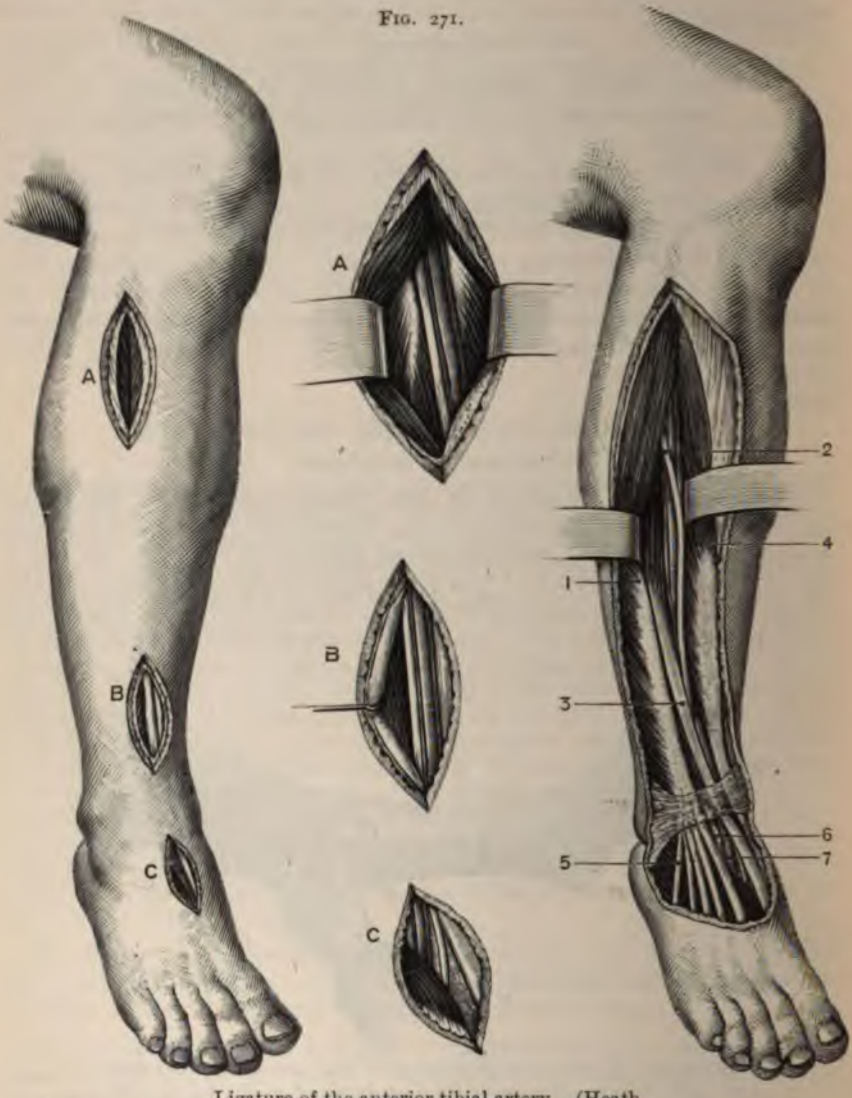
* The patient may put this into action just before the anæsthetic is taken.

be secured, and the deep fascia slit up over the line of the artery, and the finger-tip inserted to feel for the sulcus between the muscles. A third aid is almost constant, and that is a small muscular artery* which comes up between the tibialis and the extensor longus digitorum. The

FIG. 271.



Ligature of the anterior tibial artery. (Heath.

A and B, Incisions for ligature of the anterior tibial artery.

C, Incisions for ligature of the dorsalis pedis artery.

1, Extensor longus digitorum. 2, Anterior tibial vessels and nerve. 3, Extensor proprius hallucis. 4, Tibial anticus. 5, Peroneus tertius. 6, Anterior tibial nerve. 7, Dorsalis pedis artery.

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* This is pointed out by Mr. C. Heath (*Oper. Surg.*, p. 47). I have found the same thing most helpful in the ligature of the ulnar in the middle third.

sulcus being found between the muscles (without tearing them), they are separated with the handle of a scalpel or a steel director, and retractors inserted, the outer one being hooked over the fibula. If the limb is a very muscular one, the deep fascia should be nicked transversely at the upper and lower extremities of the wound, and the parts more relaxed by bending the knee more and pressing the foot upwards. The finger now directed towards the interosseous space feels for the artery deep down in the bottom of the wound. The nerve should be drawn to the outer side. If much trouble is met with in separating the venæ comites, they may be included.

In a case which still presents difficulties the following directions of M. Farabeuf may be useful (*Man. Oper.*, p. 89): The two lips of the wound having been separated, the deep fascia is opened close to the inner lip and the grooved director introduced* beneath it, and pushed across gently until its tip is arrested by the first intermuscular interval and septum, that between the tibialis anticus and the extensor digitorum. If the operator pushes it too far it will be arrested by the better marked septum between the peronæi and extensors. In cutting upon it the operator will have crossed the desired interval.

Drainage having been provided, and all hæmorrhage stopped, the wound is lightly dusted with iodoform, the muscles united with one or two chromic-gut sutures, and the wound closed, the limb being kept raised and flexed.

Operation at the Junction of the Lower and Middle Third of Leg (Fig. 271, B).—An incision about two inches and a half long is made in the line of the artery; in the upper part, this incision will be about one inch from the tibia. The white line and the interval between the tibialis anticus and the extensor proprius pollicis are both looked and felt for. The deep fascia being divided and the muscles relaxed and retracted, the artery is found surrounded by its venæ comites. The needle must be passed from without inwards.

LIGATURE OF THE PERONÆAL ARTERY.

Indications.—As these are extremely few, and as in the case of a wound of the vessel (which is very rarely met with) the best course would be to enlarge the wound, any formal operation for its ligature need only be very briefly described.

RELATIONS.—The peronæal artery comes off from the posterior tibial about one inch below the popliteus, descends at first parallel with this artery but separated from it by the posterior tibial nerve; it then passes outwards towards the fibula, and runs down between this bone and the flexor longus hallucis. In the upper part of its course it lies upon the tibialis posticus, and is covered by the soleus.

Operation.—To tie the artery when no wound is present to guide the surgeon, an incision three inches long should be made along the posterior border of the fibula, with its centre at the junction of the upper and middle thirds of the leg. The gastrocnemius being drawn aside, and the soleus separated from its attachment to the fibula, the special deep fascia is slit up, and the artery sought for close to the fibula.

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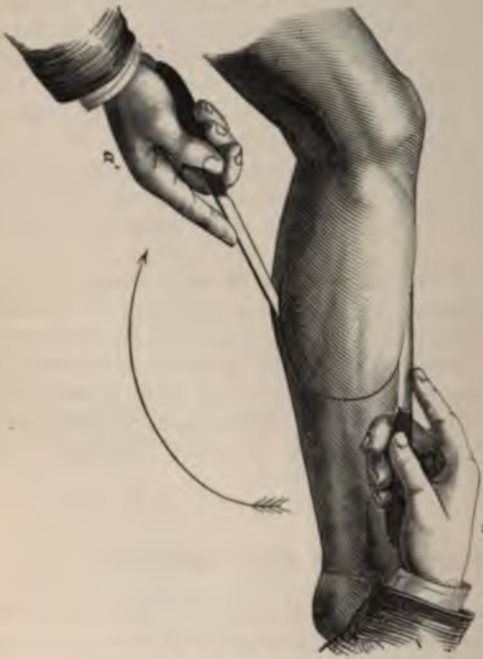
* Though in Fig. 270 M. Farabeuf figures the director introduced from without, he directs that it be passed as described above, and figures it so in another illustration.

AMPUTATION OF THE LEG.

Different Methods.—(Figs. 272–278).

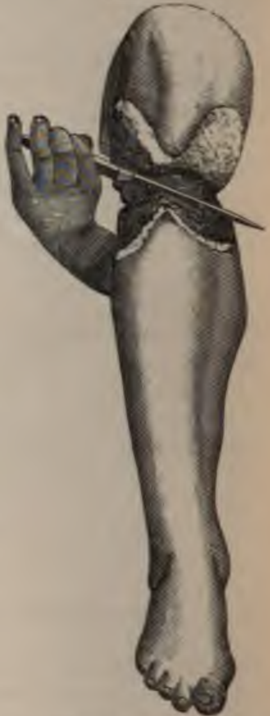
1. **Lateral Flaps** (Figs. 272–275). 2. **Teale's Rectangular Flaps** (Figs. 276–278). 3. **Antero-posterior Flaps of Skin.** 4. **Antero-posterior Flaps, Anterior of Skin, Posterior by Transfixion of Muscle.** 5. **Circular.**

FIG. 272.



Amputation of the leg by lateral flaps. (Farabeuf.)

FIG. 273.



Amputation of the leg by lateral flaps. The muscles are being severed with circular sweeps of the knife.

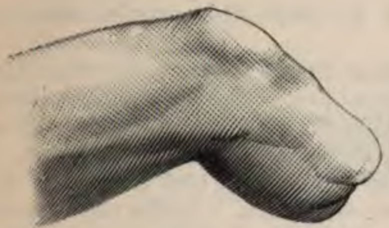
I shall only describe the first two, as they will be found adapted to all emergencies, and to be devoid of the disadvantages of the others.

1. **Lateral Skin Flaps, with Circular Division of the Muscles, &c.**—This is, I believe, a method not well known beyond Guy's and those who have been taught there. It will not only be found most convenient at the time, but it also gives very satisfactory results afterwards. The blood-supply is well and equally distributed to the lateral flaps, one can be conveniently cut longer than the other, and they are more easily

shaped and dissected up than antero-posterior skin-flaps, while no mass of muscle is left to drag away from and expose the bones, as in the antero-posterior flaps, with the anterior of skin and the posterior by transfixion.

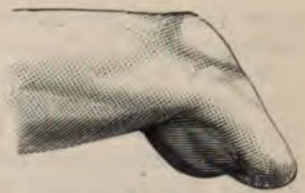
Operation (Figs. 272–275).—The femoral artery having been commanded, the leg brought over the table, and the damaged or diseased parts bandaged in carbolised lint—so as to give the assistant a firm hold and also to prevent his soiling the flaps later on—the opposite ankle is tied to the table. The surgeon, standing to the right of the limb, places his left index on the crest about an inch below the tubercle, and his thumb at a corresponding point behind in the centre of the limb. Looking over he inserts his knife close to the thumb, and cuts on the side of the limb farthest from him a lateral flap broadly oval in shape and three inches long, ending at the index finger, from which point, without removing the knife, a similar flap is marked out ending on the back where the first began. Flaps of skin and fascia are now dissected up, and the muscles all cut through with a circular sweep of the knife at the intended point of bone-section, this sweep being repeated two or three times till the soft parts are, all, cleanly severed. The posterior muscles should be cut a little longer than those in front, owing to their greater retraction (Figs. 274, 275). The interosseous membrane is next divided, so that it shall not be frayed by the saw, and with one final, firmly drawn, circular sweep the periosteum is grooved for the saw.* This is then applied with the following *precautions*. The position of the fibula behind the tibia and its much smaller size must be remembered, lest it be splintered. This may be avoided by rolling the leg well over on to the inner side, and placing the saw well down on the outer side so as to start the section of the bones simultaneously, and thus ensure complete division of the fibula before the tibia. This object may also be effected, if the leg is held in the ordinary position, by applying the saw to the tibia, and remembering, when this bone has been sawn half-through, to depress the handle, and thus complete

FIG. 274.



Amputation of the leg at the seat of election, by lateral flaps, a good stump resulting (Farabeuf.)

FIG. 275.



Amputation of the leg by lateral flaps, at the seat of election. The posterior muscles, cut too high, have retracted greatly, and an ugly conical stump is the result. (Farabeuf.)

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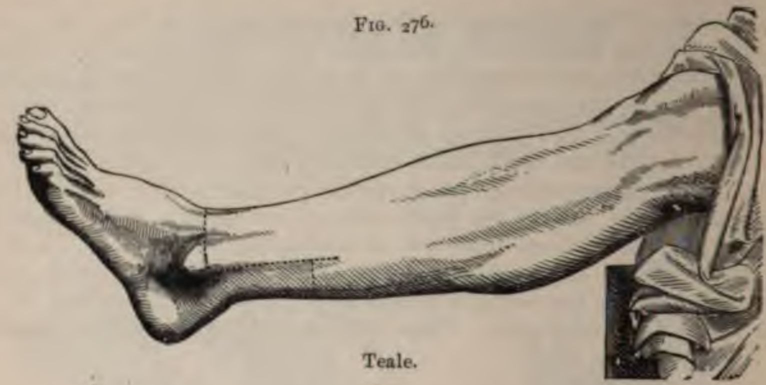
* Nowadays, with antiseptic precautions, the old need of periosteal flaps—viz., to keep pus, &c., out of the diploe and medullary canal—is no longer present. Furthermore, these flaps are very difficult to raise, unless inflamed, especially in the thin periosteum of adults.

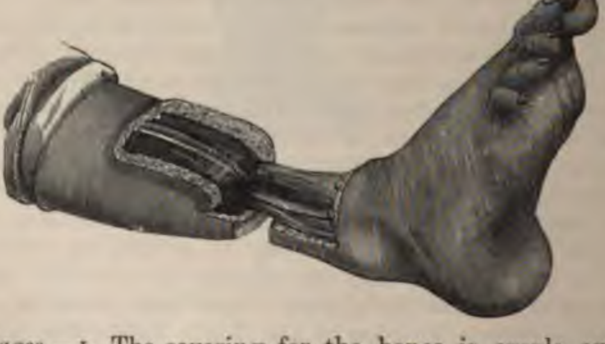
the section of the bones simultaneously. In either case the saw should be used lightly and quickly, with the whole length of the blade, and without jamming. As the sharp projecting angle of the crest tends to come through the anterior angle of the flaps, this may be sawn off obliquely after the bones are sawn.

FIG. 276.


Teale.

Teale's Amputation by Rectangular Flaps (Figs. 276–278).—This method is rarely employed. In hospital practice, where amputation of the leg is usually called for, amputation at "the seat of election," so that the patient can bear his weight on parts used to pressure, is always preferable, and lateral flaps give here the best results, at the least expense of tissue, and in the shortest time. In the better ranks of life, where the patient can afford and use comfortably a well-moulded leather socket,* a longer stump may be made, as the pressure will now not be taken on the face of the stump, but distributed over the socket.

FIG. 277.



Advantages.—1. The covering for the bones is ample, and the flaps come together without tension.† 2. The way in which the flaps are united favours drainage during healing, and provides a scar well out of the way of pressure. 3. The stump bears pressure well.

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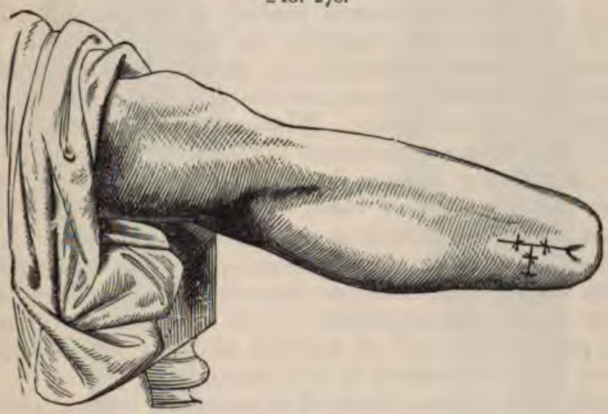
* Hospital patients occasionally ask for and get together the money, on the first occasion, for one of these expensive legs. The well-moulded socket on which the bearing of the weight comfortably depends is quite unfitted for the hard wear and tear, perspirations, &c., to which it will be submitted.

† Save when infiltrated, the difficulty of getting the anterior flap into position is then often considerable.

Disadvantages.—1. It is an expensive method, involving a high section of the bones. 2. The long anterior flap may slough. 3. If performed with the accuracy of its introducer, it involves more time than that by lateral flaps (*vide supra*), and is, thus, not suited to cases of shock.

Operation.—The preparatory steps, and the position of the operator and patient, are as at p. 673. The surgeon having measured the circumference of the limb at the spot where he intends to saw the bones, and placing here his left index and thumb on the tibia and fibula, traces out a long rectangular, anterior flap which is to be, both in its length and breadth, equal to half the above circumference.* In tracing this flap the incision starts from the index finger, runs down along the bone farthest from the surgeon for four inches and a half (if the circumference at the site of bone-section is nine inches), then crosses the limb, cutting all the structures down to the bones—this end of the flap being also four inches and a half wide—and then travels up along the opposite bone to the surgeon's thumb. The anterior flap is then dissected up partly with the knife—*e.g.*, on the inner side, where the scanty coverings must be raised as thick as possible and without scoring, partly with the knife and partly with the finger on the outer aspect, where the extensors, anterior tibial vessels, and nerves must be stripped up, uninjured, from the interosseous membrane (Fig. 277). The posterior flap, which has been previously marked out fully one-third in length of the anterior, is now made by the surgeon looking over the limb and passing his knife beneath it, and cutting everything down to the bones. It is next raised as high as the point where the bones are to be sawn. The interosseous membrane and the bones are then attended to with the precautions given at p. 673.

FIG. 278.



Teale.

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* In the lower third, where the leg tapers quickly, care must be taken to keep this flap of the same width below as it is above.

The vessels being secured and drainage provided, the anterior flap is folded over the bones (care being taken not to double it too sharply). its cut end stitched to the cut end of the posterior flap, and the portion folded below the bones stitched to that folded above them (Fig. 278).

SEQUESTROTOMY.

As the removal of necrosed bone is most frequently required in the leg, the above operation will be described here.

Indications.—The question will often arise as to whether the case is ripe for operation. The chief points bearing upon this and the looseness of the sequestrum, are—(1) The time that has elapsed since the beginning of the illness; thus, two to three months will probably be required in the case of the tibia, but more likely six in that of the femur; (2) the age and general health* of the patient. The younger the patient, and the more vigorous his vitality, the more rapidly will the sequestrum become detached; (3) the size of the sequestrum. The larger and more tubular the sequestrum, the slower will be the process; (4) the feel of the sequestrum. When steel probes announce this to be dry, hard, and ringing. exploration is justified, especially if the sequestrum can be felt to be loose or depressed by the probe; (5) the size and amount of the new shell of bone. The more distinct this is, the more probable is it that the process of separation is complete.

Operation.†—This should be always conducted with strict antiseptic precaution throughout, for these reasons—(*a*) to prevent any risk of setting up septic osteo-myelitis; (*b*) to diminish the amount of suppuration, and so the risk of necrosis after the interference with the periosteum which is entailed by the operation.

The limb, having been rendered evascular by vertical elevation while the patient is taking the anæsthetic, and the application of Esmarch's bandages, is firmly supported on sand bags, steel probes are placed in the cloacæ which mark the limit of the disease, and with a strong-backed scalpel the surgeon makes an incision between them on the inner surface of the tibia down to the bone. If only one sinus is present, this will probably be taken as the centre of the incision. This incision should be made to surround the sinus or sinuses so that the edges of these are removed. The soft parts being reflected, with every care of the periosteum, partly with the finger, partly with a blunt dissector, the new sheath of bone, spongy and vascular, is thoroughly exposed. This is then cut into and sufficiently removed with a chisel and mallet, to expose its cavity completely from end to end.‡ The sequestrum is now removed with sequestrum-forceps, or prised out with an elevator. If too large, it must be divided with cutting-forceps. The bed of ill-formed granulation-tissue in which the sequestrum lay is then carefully examined for any small bit which may be concealed, and this tissue, together with that lining the sinuses, is all scraped away with a sharp spoon, and the cavity left thoroughly cleansed by free swabbing with hot carbolic solution (1 in 30). When the surgeon is satisfied that all the mischief has been removed, he plugs the resulting cavity carefully with gauze wrung out of carbolic lotion (1 in 20), dusted with iodoform, bandages these dressings firmly on while the limb is elevated, and not till then removes the Esmarch's bandage. If the bandage is removed before the dressings are applied, such free venous oozing takes place that the plugs are at once loosened and rendered inefficient, and the wound has to be redressed shortly. The limb is kept raised on a back splint and an injection of morphia given, if needed.

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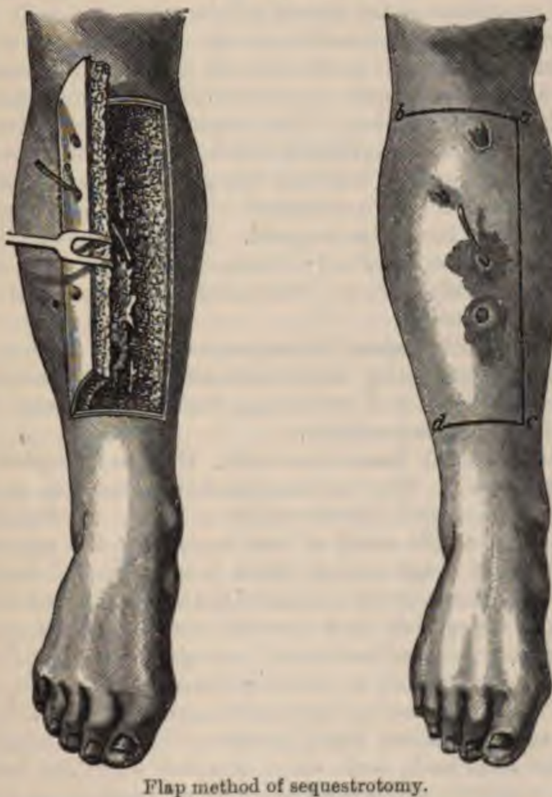
* Freedom from syphilis and phthisis will be noted.

† It is supposed here that the sequestrum is one of considerable size.

‡ Mr. Howse (*Brit. Med. Journ.*, 1874, vol. i. p. 475) lays great stress on the need of this. The new bone should be removed as far as the probe can be passed upwards or downwards inside it, so as to make the whole easily granulate up from the bottom. Otherwise, the part that is not laid open will very likely persist with a sinus. Furthermore, laying the whole cavity open not only ensures its granulating up from the bottom, but also allows of the removal of all ill-formed granulation material.

FIG. 279.



Flap method of sequestrotomy.

In order to curtail the period of after-treatment, which is extremely prolonged and tedious owing to the slowness with which healing takes place in the large cavity left, an attempt may be made in some cases to raise a flap which includes the anterior portion of the involucrum, as shown in Fig. 279. The flap *b a c d* is first marked out by skin incisions passing down to the bone, and the latter then divided along the lines of incision with a sharp chisel or osteotome. This having been done, the flap is prised up sufficiently to expose the cavity in which the sequestrum lies, and the latter then removed. All the granulation tissue lining the cavity and the sinuses is now thoroughly removed with a sharp spoon, and the skin forming the margins of the sinuses excised. The cavity in the bone, the sinuses, and the surrounding skin are now thoroughly cleansed with hot carbolic solution (1 in 30) or biniodide of mercury solution (1 in 1000), the flap replaced and sutured, and the wound dressed. In a few cases thus treated, where the attempt at rendering the wound aseptic has been successful, rapid healing by organisation of blood-clot may take place.

A further attempt may be made to promote primary union, where either the old operation or the above modification has been performed, by the use of *decalcified cancellous bone*. The success of this plan depends entirely upon the production of an aseptic wound. Every effort must therefore be made by thorough curetting, and cleansing with antiseptics, to attain this. The decalcified bone is introduced in small pieces together with sterilised iodoform until the cavity is filled. The wound is now closed by suturing the periosteum, and then the skin if the old operation has been performed, or by replacing the flap if the osteo-plastic method has been adopted. Primary union will only take place if asepsis has been obtained; if not, suppuration will occur, when the cavity will probably have to be cleared out and made to heal from the bottom by granulation.

Two questions with regard to sequestrotomy require to be alluded to—viz., that of performing **early sub-periosteal resection**—*i.e.*, as soon as the bone is dead, and before any shell of new bone has formed around it, and that of **amputation.**

Early Sub-periosteal Resection.—Mr. Holmes (*Surgical Treatment of Children's Diseases*, p. 385) has discussed this question, and given the following *advantages* and *disadvantages*: "The *advantages* of sub-periosteal resection of the shaft of the bone over the expectant treatment are: (1) That it takes away what is a source of very acute and dangerous constitutional irritation, and (2) that it avoids the embarrassment of future operations, and the tediousness of the convalescence which follows on the invagination of a large sequestrum." The chief *drawback* is the risk of more or less shortening.

The certainty of shortening here, although the fibula is present to act as a stay, to prevent any approximation of the ankle to the knee, is a most serious drawback, and when coupled with the fact that the patients who would be submitted to early sub-periosteal resection are often only just recovered from a very prostrating illness, seems to me to be strongly against it in most cases.

Question of Amputation.—The following are some of the conditions which will call for this operation: (1) When the patient's vitality is so low as to be unable to repair the wound of an early sub-periosteal resection, or to stand the tax upon it of the expectant treatment; (2) When the epiphyses are perforated, and the knee or ankle (especially if both are affected) are involved; (3) If a condition of chronic septicæmia is present; (4) If the general health, from the presence of phthisis, lardaceous disease, or syphilis, is much impaired.

TREATMENT OF COMPOUND FRACTURES.*

The following **special points for consideration** arise here—viz., (1) The reduction of protruding fragments and the treatment of splinters; (2) The treatment of the wound; (3) Complications; (4) The question of amputation.

(1) *Protrusion of Fragments.*—It is usually the upper one which protrudes. The difficulty of reduction is in proportion to the obliquity of the fracture, the length of the protruding bone, and the amount of spasm. The wound having been freely enlarged, an attempt must be made by extension and rotation to bring the fragments into accurate apposition. This will often be facilitated by means of a strong elevator inserted between the fragments, and used as a lever. Division of the tendo-Achillis or possibly of other tendons may also be found necessary before satisfactory reposition can be accomplished. Failing all these, part of the bone must be removed with a narrow-bladed saw (Adams' osteotomy saw will be found very useful), care being taken to separate the periosteum first, and to protect the soft parts with a blunt dissector passed under the bone and by retractors. If the bone is splintered, some judgment is required as to what pieces to remove. Those which are still adherent by their periosteum should be left. Those completely torn away must be removed, whether they carry their periosteum or not. As to a third set partly adherent, partly not, these, as a rule, partially die in proportion to the injury to their periosteum, and keep up for a long time irritation, and delayed union with, perhaps, suppuration, &c. They must, therefore, as far as practicable, be removed. If after reduction it is found that there is any considerable tendency to the reproduction of the deformity, the fragments must be fixed either by means of silver wire, steel screws as suggested by Mr. W. A. Lane, or Parkhill's clamp (*vide* p. 631), the choice between these methods depending upon the conditions present and the practice of the surgeon operating.

(2) In *the treatment of the wound* the one great object is to convert the fracture as soon as possible into a simple one. In a few cases, sealing a small, *clean cut* wound at once with dry gauze, and collodion and iodoform, or tinct. benz. co., may be sufficient. But in those cases, common enough in large hospital practice, where the wound is extensive and lacerated, and accompanied by great contusion of the soft parts, with abundant blood extravasation, with much comminution of fragments and injury to the periosteum, or where the fracture is complicated with a dislocation, the following method will be found to give the best results.

While an anæsthetic is given, the whole limb is thoroughly cleansed with turpentine, hot soap and water, and warm 1 per cent. lysol solution. The wound having been freely enlarged and all recesses well opened up, and any portions of ragged skin and muscle trimmed off, the blood-clot is washed away and the whole surface of the wound thoroughly rubbed over with swabs soaked in hot carbolic solution (1 in 30) or biniodide of mercury (1 in 1000). The fragments are now reduced and fixed as already described (*vide supra*), and counter punctures made for drainage as may be found necessary. All hæmorrhage being now arrested, and any torn nerves pared and sutured, the recesses of the wound are dried with sponges on holders; powdered iodoform* is then dusted in, dressings of carbolised iodoform or cyanide gauze applied, and the limb put up either in a back and two side splints, or, according to Mr. Croft's directions, in plaster of Paris. Of the two I prefer the former, in severe cases, for the first week; infrequent dressings, wherever practicable, are most essential.

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* From the frequency with which these occur in the leg this subject will be treated here. The account is taken largely from the article "Fractures," *Syst. of Surg.*, vol. i p. 421, which I re-wrote in 1882.

(3) *Complications.*—My space will only allow me to enumerate these. They are local and general. The former include pruritus, vesicles, ecchymosis, suppuration, œdema, phlebitis, gangrene, ostitis, caries, necrosis, muscular spasms, dislocations, and implication of a neighbouring joint. The general complications are such as are common to all injuries—viz., traumatic fever, delirium, erysipelas, septicæmia, pyæmia, hectic, tetanus, jaundice, and retention of urine; in older patients a tendency to hypostatic congestion and broncho-pneumonia, and finally, in a few cases, pulmonary fat-embolism.

(4) *Question of Amputation.*—The following are amongst the conditions requiring primary amputation: (1) When a limb is torn off by a cannon-ball, a portion of shell, or by machinery. (2) When the division of the soft parts is nearly complete, except in the case of a clean cut across the phalanges, metacarpus, or metatarsus; even the forearm may occasionally be saved under similar circumstances. (3) When there is much actual loss of soft parts, as when one side of a limb is torn away, or the skin is extensively peeled off. (4) When, with or without great comminution of the bones, there is much bruising and laceration of the soft parts, with protrusion of muscular bellies, and extensive tearing up of deep planes of areolar tissue. (5) In some cases when the principal artery and nerves of the limb are both divided, thus, in the case of the lower limb, primary amputation will usually be required. (6) In certain cases of severe hæmorrhage, primary or

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* This most valuable drug is not sufficiently used in these cases. I may briefly mention three cases in which limbs were, I think, saved by it. One was a very severe compound fracture of the femur in a man, aged 46, who fell twenty-two feet on to the banks of the Thames, striking a stone buttress as he went down. I saw him about an hour after the accident. The fragments were much displaced and overlapping, the lower one being also split vertically, but not so far as the knee-joint. The ends of both were bare, and the vastus externus and hamstrings were lacerated, the injury having been made greater by the patient having been lifted off the mud on to which he fell into a boat, and then into a cab. Ether having been given, the external wound, through which the vastus externus protruded, was freely enlarged, and its recesses well washed out with 1 in 30 carbolic acid solution, as advised above. About ʒj of iodoform was then carried down right between the fragments by means of the finger and a narrow spatula, and two large drainage-tubes inserted. An aseptic result was secured from the first and maintained, throughout, by the dresser (Mr. J. H. Lister), the man making an excellent recovery. The second case was that of a compound comminuted fracture of the leg, with wound of the anterior tibial artery (mentioned at p. 668). The third occurred in a boy with compound separation of the lower epiphysis of the tibia, in which two inches of the protruding diaphysis were removed. The case did so well after the introduction of iodoform and the other precautions already given, that the first dressings were not removed till the eighth day, and the lad recovered with an excellent limb.

secondary. On this subject I must refer my readers to the remarks already made at p. 663. (7) Some cases of compound fracture of large joints—viz., when one bone is shattered or more than one is broken; when there is much laceration of the ligaments; when, in addition to comminution of the bones, there is much contusion of the soft parts, especially if complicated with division of an artery; when the foreign body which has caused the fracture remains in the joint, or, projecting into it from its bed in the bone, cannot easily be removed, or when there is much damage to the articular surfaces. It will be understood that all these forms of injury are most fatal when affecting the knee or hip; in dealing with other joints much greater latitude may be allowed.

Finally, before deciding on amputation, the surgeon must take into consideration, in addition to the above points which concern the fracture itself, any general information to be gained about the patient himself. Thus, the age, constitution, habits, any sign of visceral disease, and the appearance of the patient, are all points of material importance in coming to a decision between amputation and an attempt to save the limb. Thus, to make my meaning clearer, there are no more anxious cases than severe compound fractures in dwellers in large towns, who are past middle life, flabbily fat, with dilated venules about the cheeks and nose, whose conjunctivæ are slightly jaundiced, the urine of low specific gravity and perhaps albuminous.* The surgeon must here bear in mind that saving the patient's life is, after all, of more importance than the preservation of his limb.

In performing amputation in these cases of compound fracture it is always to be remembered that the injury is not so localised as would appear from the surface; thus, in compound fracture of the leg there is often extensive loosening of the skin from the deep fascia, and extravasation of blood into the deep planes of connective tissue for some distance above, the knee-joint being perhaps full of blood, and its cartilages bruised. In such cases, if amputation be performed just above the injury, sloughing and separation of the flaps will inevitably follow. On the other hand, in cases of severe compound fracture of the thigh, where amputation is required high up, it will be found better practice to amputate, in part at least, through injured tissues.†

If, in addition to the fracture, there are serious injuries to other organs, immediate amputation is useless or injurious. The only chance of recovery here is afforded by secondary amputation after the early dangers are past.

Secondary amputation may be required for profuse suppuration with hectic, for gangrene, or uncontrollable hæmorrhage. The decision must here be made according to the needs of each case. The surgeon must, if possible, wait till the traumatic fever and constitutional

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[*] Note will also be taken of the occupation, as in brewers' draymen and commercial travellers.

[†] Thus, in the case of a young railway porter, whose thigh was smashed by a railway accident at Epsom, I performed amputation at the level of the lesser trochanter, in preference to the hip-joint. The damaged flaps sloughed, as I expected, but the patient made a good recovery, after the removal of some dead bone. The precautions already given against shock (p. 584) will, of course, be taken in these cases.

disturbance are subsiding, till the temperature has begun to fall, and till all redness, erysipelas, and sloughing have ceased. On the other hand, if the operation be deferred till the powers of the patient are running down from profuse suppuration and hectic, and till confirmed asthenia has set in, the period of performing it will, very probably, have passed away.

At a still later period the operation may be desired by the patient, if, in consequence of non-union, incurable deformity, or tedious bone disease, the limb has become an encumbrance to him. Some of these conditions may, of course, be treated by resection, osteotomy, &c.

OPERATIVE TREATMENT OF SIMPLE FRACTURES.

Since Mr. W. A. Lane (*Clin. Soc. Trans.*, vol. xxvii.) first brought forward the proposition that certain simple fractures of the leg should be treated by open incision and fixation of the fragments by mechanical means, considerable attention has been drawn to this subject. Although opinions are still much divided, there can be no doubt that under certain circumstances such treatment is the best. The truth of Mr. Lane's original contention, that certain of these fractures could not be satisfactorily reduced by any means short of operation, was certainly not fully realised until the perfection of radiographic methods made it possible to accurately observe the effects of extension and the other means usually employed in the treatment of such cases.

The radiograph has, however, demonstrated the fact that repeated attempts at reduction by extension and manipulation, however skilfully conducted, will fail to produce a satisfactory result in certain cases of spiral and oblique fractures of the tibia. A free incision renders it possible to overcome the displacement, first by permitting the removal of the effusion and blood-clot upon which the displacement is largely dependent, and second by allowing of direct leverage of the fragments in the required direction.

The chief objection is the increased risk to the patient, in other words the dangers of *wound infection*. Although the risk of converting a *simple* into a *compound* fracture, when all the necessary precautions can be taken, and when the surgeon and his assistants are thoroughly conversant with the details of aseptic surgery, is a comparatively small one, yet it must be borne in mind that the conditions here are not all that can be desired for the performance of an aseptic operation. For it must be remembered, in the first place, that the skin is often in such a delicate and injured condition as to render its proper preparation far from easy, and in the second place that the operation is performed upon tissues already much damaged, and hence peculiarly liable to infection. The risk should, on the other hand, compare favourably with that incurred in operating upon a recent fracture of the patella, since this involves the opening of the knee-joint.

Before deciding to operate upon any given case, the following points should be carefully considered:—(1) *Age.*—Only in a young, healthy patient, with a prospect of a long and active life, should operation be advised.

(2) *Sex.*—This treatment will very rarely be necessary in women in them the limb will not be required to bear heavy strains.

(3) *Occupation.*—This is of great importance, for a sufficiently good result will be usually obtained by means of splints, massage, etc., unless the occupation is a laborious one necessitating the putting of great strains upon the fractured limb.

(4) *General health, habits, etc.*—The bearing of intemperance, renal disease, diabetes, etc., will be considered here.

Where the above conditions are favourable to operation—where the surroundings, as regards the proper carrying out of an aseptic operation, are satisfactory—and where repeated attempts controlled by radiography have failed to satisfactorily correct the displacement—operation should be undertaken.

The cases thus requiring operative interference will be as follows:—

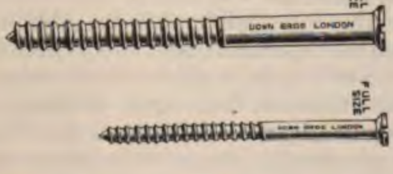
1. Certain cases of spiral fracture of the tibia.
2. A few instances of oblique fracture of the tibia.
3. Certain cases of Pott's fracture.

Operation.—The skin of the whole leg must be carefully shaved, then gently cleansed with hot water and soap, ether, and then a 1 in 500 solution of biniodide of mercury in methylated spirit, and a dressing of bicyanide gauze applied for twenty-four hours.

After the patient has been anæsthetised the skin should be again cleansed with the biniodide of mercury or other antiseptic solution. A very free longitudinal incision is now made over the seat of fracture down to the bone, and the soft parts carefully separated sufficiently to thoroughly expose the fragments.

All hæmorrhage must now be arrested, and the blood-clot around the seat of fracture removed by sponging or irrigation, any jagged or much lacerated muscular tissue being snipped away with scissors. The next step is the *reduction of the displacement*, and is often extremely difficult. While suitable extension is made by assistants pulling upon the upper part of the leg and the foot, the surgeon prises the fragments into their correct position by means of a strong elevator and lion forceps, any comminuted fragments being at the same time accurately fitted into their proper positions. While the corrected position is maintained by lion forceps and extension, the fixation of the fragments is carried out. The means of accomplishing this will depend upon the shape of the fragments and the choice of the surgeon. Silver wire, screws, plates, the Parkhill clamp (p. 631), and a number of other appliances have been made use of by different surgeons. Of these strong, pliable silver wire is certainly the most generally useful, and will be found efficient for nearly all cases. The Parkhill clamp has, however, given very [illegible] results in [illegible] of cases, and is well worthy of an

FIG. 280.

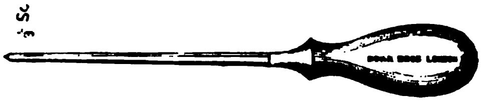


extended trial; the chief objections to it are its costliness and the resulting open wound.

If screws are used they should have a wide thread, the best being those recommended by Mr. Lane (*vide* Fig. 280), which have a small head, and taper but slightly.

Having decided upon the means to be employed, the surgeon now proceeds to drill the bones in whatever direction is most suitable for the particular case. The drills should be sharp and well tempered, those made by Weiss for Mr. Lane being as suitable as any. If a screw is to be inserted the drills used should be a size smaller than the screw; the upper part of the hole must then be enlarged with a reamer (Fig. 281) of the same size as the shank of the screw; and a counter-sink should also be made, for the head of the screw, with a burr. The fragments having been securely fixed, the wound is well dried, and then sutured, a small drain being left in for twenty-four hours if there is much bruising. Dressings and a splint are then applied.

FIG. 281.



EXCISION OF VARICOSE VEINS.

This method, as old as the times of Celsus, and one which fell into disuse from the risks of pyæmia, &c., was revived with safety some years ago by Mr. Davies-Colley (*Guy's Hosp. Reports*, 1875, p. 431), when Lord Lister had shown how the old dangers might be avoided.

Indications.—Safe as this operation has been made, it is to be recommended with caution owing to the great risk of recurrence. If this operation is largely employed, and the cases are carefully watched, it will be found after some years that the amount of permanent benefit ensured is, in many cases, very small.

Before the varices are removed it must be ascertained that the better supported deep veins, through which it is intended that the blood shall largely return after the superficial ones are obliterated, are healthy.* The cases best suited for operation are: (1) Where only one vein-trunk is involved, at one or two definite parts of its course. (2) Where both saphenous veins are involved, but again definitely and locally. The more the varices are longitudinal, the more they lie in the lines of the trunk, the more longitudinal incisions will suffice, the more satisfactory the operation and the better and more lasting the results. On the other hand, where the enlargement is bilateral and general, where numerous communicating veins between the trunks are enlarged, where the venous radicles are becoming dilated and their ramifications plexiform, the more, in short, that the disease shows signs of being a general one, the more will the result be disappointing. Finally, the soft parts near the varices should be in a healthy condition, free from dermatitis, and thus capable of being rendered aseptic, and of uniting quickly afterwards. In the two following conditions operation may occasionally be called for, though the conditions required above are not now always present. (3) Where many varices exist, but one or two are especially troublesome. (4) Where many varices exist, but one especially is, definitely, the cause of an ulcer troublesome to heal, and perhaps already the source of dangerous bleeding (Fig. 282).

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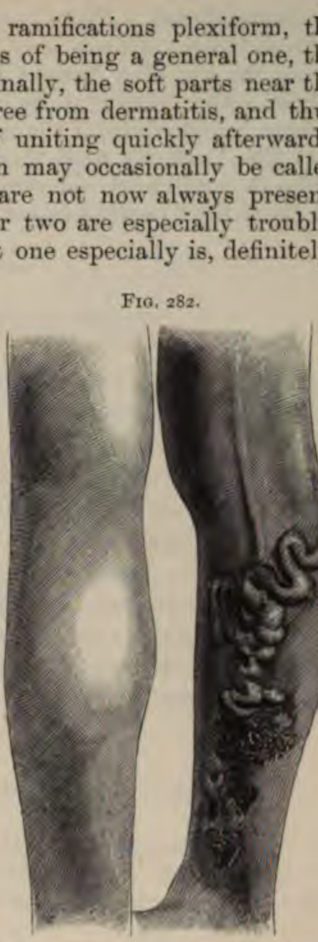
* A full, tumid condition of the calves points to a varicose state of the sural veins, and is against operation.

Operation.—The skin of the limbs should be shaved and prepared the day before the operation, and the course of the varicose veins then marked out in the following manner. The cleaning of the skin having been completed, the patient should stand in order to distend the veins, the outlines of which are then marked on the skin with carbolic fuchsin solution, applied either with a camel-hair brush or a match-stick. An antiseptic dressing is then applied and left in place until the time of operation. The patient having been anæsthetised, and the dressings removed, longitudinal incisions are made over the chief varices—where the trunk is merely dilated segments about three inches long should be removed—the subcutaneous fat opened, the vein exposed by light touches of the knife of the whole of the extent which it is proposed to excise, a fine ligature is then tied round the lower end, the vein, held in dissecting forceps, is cut through just above the ligature, dissected out, any branch-veins clamped with Spencer Wells's forceps, until the upper extremity of the wound is reached, when another ligature is tied round the vein, and the varix removed. Any clamped points are then tied, and the wound closed by a trusted assistant, while the operator proceeds to deal with another vein. I will venture to commend the following **cautions** to my younger readers. (1) The strictest aseptic precautions will, of course, be taken throughout. (2) Care should be taken in exposing the varix; though, from its position, this may appear to be part of a main trunk, it may only overlap this, which may need no interference (Davies-Colley, *loc. supra cit.*). (3) Every bleeding-point should be carefully tied, otherwise tension will occur, undermining of the edges of the wound by blood-clot, suppuration and delayed healing. (4) The close proximity of the nerve-trunks must

FIG. 282.



Case of varicose internal saphena vein with dermatitis and ulceration below. From the ulcer severe hæmorrhage had occurred. I saw the woman three years after the operation on the varicose veins, and she remained well, but I have lost sight of her since.

be remembered. Hasty operating may easily lead to removal of part of one of these. This is only justifiable when varices are being removed from the leg of a patient who complains bitterly of the pain caused about either malleolus by a clump of plexiform dilated varices, and where it is doubtful if the removal of the varices above will relieve this. (5) The ligatures used should be fine and thoroughly prepared, otherwise they will work out vexatiously, a result rendered the more probable if the patient persists in getting about too early.

CHAPTER VII.

OPERATIONS ON THE FOOT.

LIGATURE OF THE DORSALIS PEDIS.—SYME'S AMPUTATION. —ROUX'S AMPUTATION.—PIROGOFF'S AMPUTATION.—SUB-ASTRAGALOID AMPUTATION. — EXCISION OF THE ANKLE.—ERASION OF THE ANKLE.—EXCISION OF BONES AND JOINTS OF THE TARSUS.—EXCISION OF ASTRAGALUS.—EXCISION OF OS CALCIS.—MORE COMPLETE TARSECTOMY FOR CARIES. — REMOVAL OF WEDGE OF BONE, AND OTHER OPERATIONS FOR INVETERATE TALIPES.—CHOPART'S AMPUTATION. —TRIPIER'S AMPUTATION.—AMPUTATION AT METATARSO-PHALANGEAL JOINT.—AMPUTATION OF THE TOES.

LIGATURE OF THE DORSALIS PEDIS (Fig. 283).

Indications.—Very rare. (1) Wounds. (2) Together with the posterior tibial in the lower third, for hæmorrhage from punctured wounds of the sole resisting other treatment. (3) For some vascular growths of the foot.

LINE.—From the centre of the ankle-joint to the upper part of the first interosseous space.

GUIDE.—The above line and the adjacent tendons of the great and second toe.

RELATIONS: IN FRONT.

Skin, fasciæ; branches of saphenous veins, and of musculo-cutaneous and anterior tibial nerves.
A special deep fascia continuous with the sheaths of the adjacent tendons.
Extensor brevis (innermost tendon).

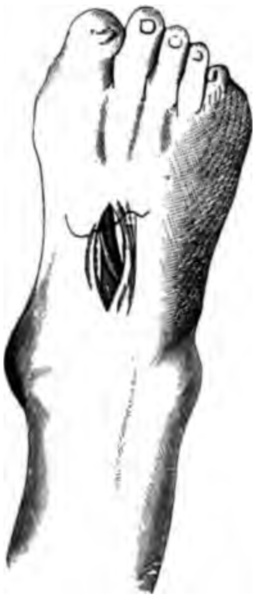
OUTSIDE.		INSIDE.
Vein. Anterior tibial nerve. Extensor longus digitorum.	Dorsalis pedis artery.	Vein. Extensor longus pollicis.

BEHIND.

Astragalus; scaphoid; internal cuneiform.

Operation (Fig. 283).—The foot having been cleansed, an incision about an inch and a half long is made in the line of the artery, in the lower part of its course, commencing about an inch and a half below the ankle-joint. Skin and fasciæ being cut through, and any superficial veins tied with chromic gut or drawn aside, one of the long extensors is found (its sheath is not to be opened), and the strong fascia given off from them opened. If the extensor brevis cross the artery at this spot it must be drawn aside. The ligature should be passed from without inwards.

FIG. 283.



The dorsalis pedis (too much of the artery is shown cleaned) is seen lying between the extensor longus pollicis and digitorum, and crossed by the innermost tendon of the short extensor.

SYME'S AMPUTATION.

(Figs. 284 and 287.)

An amputation at the ankle-joint by a heel-flap, with removal of the malleoli.

Operation.—Hæmorrhage having been controlled, any sinuses present scraped out, the foot bandaged,* and held at right angles to the leg, the surgeon, standing a little to the right, but so as easily to face the sole, makes, with a short, strong knife, an incision (in the case of the left foot) from the tip of the external malleolus to a point half an inch below† the internal one, this incision not going straight across the sole as in Pirogoff's amputation, but pointing a little backwards towards the heel.‡ The horns of this incision are then joined by one passing straight across the joint,§ and severing everything at once down to the ankle-joint. The foot being now strongly bent downwards, the lateral ligaments are severed, and the joint thus fully opened. The foot being slightly twisted from side to side, the soft parts on either side are carefully divided, especial precautions being taken on the inner side to cut the posterior tibial artery as long as possible (to ensure getting below the internal calcanean) and not to prick it afterwards.

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* So as to give a grip, and also to prevent the assistant's hands from being septic when he supports the stump a little later.

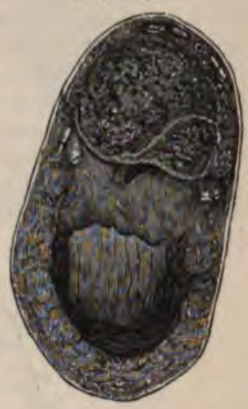
† The directions usually given are to go behind this point as well as below it, but by following the above course the posterior tibial is more likely to escape section before its time, and the flap will be found sufficiently symmetrical.

‡ If the foot is small, and, still more, if the parts on the dorsum are damaged, the plantar incision should run straight across. On the other hand, the more prominent the heel, the more should the flap point backwards. This will facilitate turning the flap over the heel.

§ Or with very slight convexity. If anything of a flap is made here, the operator is liable to get away from the joint and cut into the neck of the astragalus. Moreover, the parts are not well nourished, especially if sinus-riddled or undermined.

The foot being still more depressed, the upper non-articular surface of the os calcis comes into view, and then the tendo-Achillis. This is severed, and the heel-flap next dissected off the os calcis from above downwards, special care being taken to cut this flap as thick as possible, not to score or puncture it, but rather to peel it off the bone with the left thumb-nail kept in front of the knife, aided by touches of this.[*]

FIG. 284.



The parts in a Syme's amputation before the heel-flap is adjusted (left side). The bones are shown above with the extensor tendons and the anterior tibial vessels, and, below, the tendo-Achillis. On the inner side the flexor tendons and the plantar arteries are shown cut; on the outer side, the peronæi. This figure should be contrasted with Fig. 290.

The foot having been removed, the soft parts are carefully cleared off the malleoli, and a slice of the tibia sufficiently thick to include these prominences removed. This slice should in any case, to avoid shortening, be the thinnest possible. Prof. Macleod[†] has recommended to remove only the malleoli, leaving the cartilage on the under surface of the tibia. I have followed his advice in my last eleven cases—in one, a private patient of 63, where I had not the carrying out of the after treatment, the cartilage exfoliated. The others were all younger patients—in one, in addition to the disease of the tarsus, active secondary syphilis was present; in all, in spite of tubercular sinuses in three which required repeated scraping out (Fig. 287), no exfoliation took place. If the stump can be kept aseptic, Prof. Macleod's advice seems to me well worth a further trial, as it entails less shortening of the limb and does away with the risk of septic phlebitis, which may be brought about by opening the cancellous tissue. If, on the other hand, the lower end of the tibia is diseased, it must be removed and the sawn surface gouged or treated with a sharp spoon. If the cartilage is only slightly diseased, it may be sliced off with the knife, and here and there treated with a gouge.

Tendons are now cut short, sinuses laid open or thoroughly scraped out, and the vessels secured. Free oozing is often present in chronic pulpy cases, or where the periosteum has been left in the heel-flap. It is best treated by firm pressure with dry dressings, and elevation of the stump. Drainage having been provided, the sutures are inserted; where many sinuses have been present along[‡] the line of the incision, it is no good uniting the wound closely.

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[*] If, in a young subject, the epiphysis comes away in the heel-flap, it may remain there if the parts are healthy. The same course may be followed with the periosteum, if it is found loose and peels easily away. Mr. Johnson Smith, when amputating both feet for frost-bite, left the periosteum on one side. On the other no attempt was made to save it. The first stump was much larger than the other, harder, and more rounded; more like that of a Pirogoff's amputation.

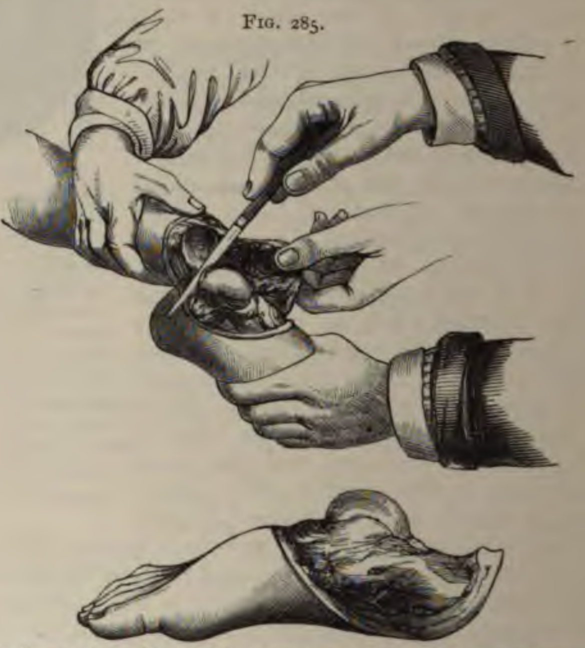
[†] *Brit. Med. Journ.*, 1869, vol. ii. p. 239.

[‡] Sinuses which have been scraped out will give good drainage if enlarged. If any puncture has been made in the heel-flap, it should be utilised for the same purpose. Where a diseased foot has been long on a back-splint, the skin over the tendo-Achillis

Roux's Modification of Syme's Amputation (Figs. 285 and 286).—In cases where a satisfactory heel-flap cannot be obtained, an efficient substitute can be got by a large internal flap.

The incision is commenced at the apex of the outer malleolus, and carried half across the front of the ankle-joint, from whence it should run inwards in an oblique direction over the astragalo-scaphoid joint, then pass, in a curved manner, downwards and backwards to the middle line of the sole of the foot, and, running along the under surface of the heel, ascend the posterior aspect of that part, and terminate at the outer malleolus, where it commenced. The ankle-joint should be opened at its upper and outer part, the os calcis dissected from its connections, the malleoli and a slice from the articular surface of the tibia removed, and the operation will be complete. The shape of the flap will be gathered from the appearance of a foot operated upon (Fig. 285).

FIG. 285.



Roux's amputation at the ankle-joint by an internal flap. Below is shown a foot upon which the operation has been performed. (Smith and Walsham.)

Causes of Failure after Syme's Amputation.—(1) Sloughing of the heel-flap. This is nearly always due to faulty operating, to scoring or "button-holing" the flap, or to dividing the posterior tibial high up.* (2) Persistence of sinuses and tubercular disease. If, in spite of repeated scraping out (Fig. 287) with the aid of anæsthetics, this condition recurs inveterately and spreads along the sheaths, the limb must be

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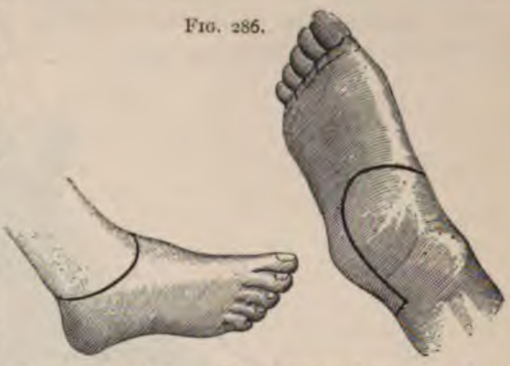
may be so thinned that it is advisable to make a counter-puncture here and insert a tube.

* If possible, the cut ends of the two plantar arteries should always be seen, and not the single mouth of the posterior tibial. In the former case the surgeon is certain that the main vessel is divided below the internal calcanean branch.

amputated higher up. This will, however, be rarely called for with perseverance on the part of the surgeon to treat this condition as a kind of malignant disease. If one or two sinuses remain, and look likely to persist, scraping out should be resorted to at once. (3) Recurrence of caries in the tibia. (4) Death of the tendo-Achillis.

This rare sequela occurred to me in 1890. The patient was an aged inmate of the Camberwell Infirmary. A bluish undermined patch being laid open on the back of the ankle some weeks after the amputation, the tendon was found to have died up to its junction with the calf muscles. After its removal the parts healed soundly.

FIG. 286.



Roux's amputation. The incisions shown from the outer and the inner side. (Stimson.)

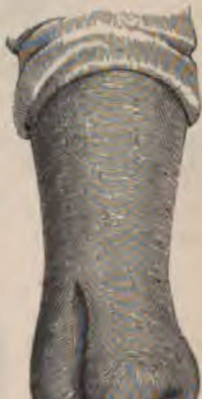
PIROGOFF'S AMPUTATION

(Figs. 288–291).

An amputation at the ankle-joint, in which the posterior part of the os calcis is retained and united to the sawn surface of the tibia.

Question of the Value of this Operation especially as compared with Syme's Amputation.—*Disadvantages:* These have been put prominently forward by Scotch surgeons. 1. The amputation is not suited for cases of disease, except of distinctly traumatic origin in young healthy subjects. 2. Occasionally the sawn os calcis fails to unite, causing either a kind of movable joint or necrosis. 3. It is said by some that the stump is more difficult to fit with an artificial foot.* The first two objections are undoubted, but I think that they are quite outweighed by the *Advantages:* 1. No dissection of the heel-flap is needed. 2. The blood-supply is less interfered with. 3. The stump is firmer and more solid. 4. The stump is longer by one inch or one inch and a half, often more.† 5. The stump does not go on wasting, as is the case after a Syme's amputation.‡ 6. Dr. Hewson

FIG. 287.



A Syme's stump soundly healed after scraping out of sinuses had been resorted to. The patient was sent to me by Dr. Fraser, of Romford, and had active secondary syphilis as well as extensive caries of the tarsus.

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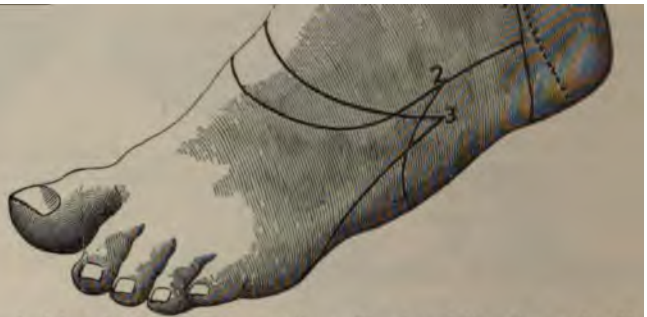
* Prof. Macleod thinks that the presence of the heel is here "a great drawback, and that the back of the heel, not the firm plantar pad, is what comes in contact with the ground." See the remarks p. 694.

† Dr. Hewson (*loc. infra cit.*) gives the shortening after a Pirogoff as from one to two inches; that after a Syme as two and a half to three inches.

[illegible] ontinuance of this wasting is shown by the hospital patient being for some [illegible] d to stuff the socket of his elephant-boot with a sock. It is not intended



1. The incisions in Pirogoff's amputation. The dotted line shows the dir
of the plantar incision in that of Syme. 2. The incisions in sub-astragaloid
3. Those in Chopart's amputation.

intact, the combined movements of the knee and ankle are pr
as in running, &c.

Fig. 289.

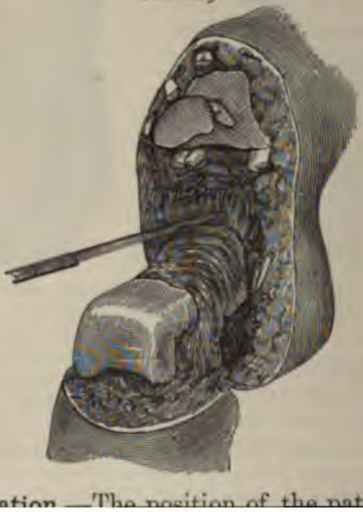
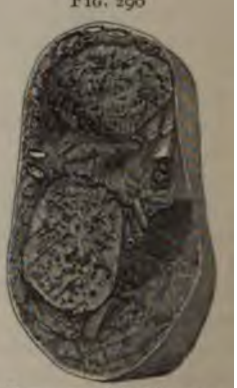


Fig. 290

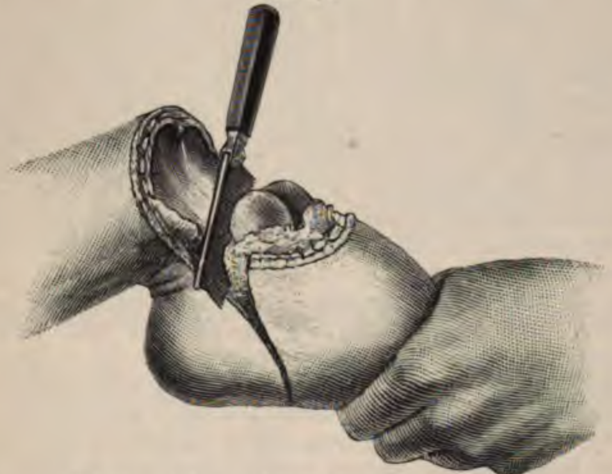


Compare with Fig. 284.

Operation.—The position of the patient's foot and the surgeo

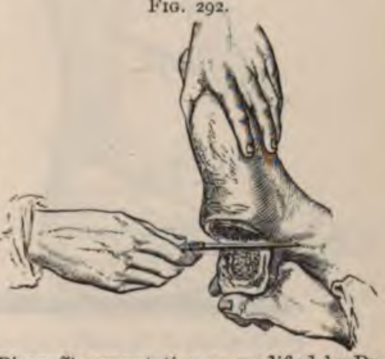
This incision goes right down to the bone. Its horns are then joined by a transverse cut across the front of the ankle. The lateral ligaments are now severed, care being taken to cut inside the malleoli and to divide the posterior tibial artery as long as possible—*i.e.*, below its origin into the two plantar—and not to prick it after it is divided. With a few touches of the knife at either side of the astragalus, aided by twisting of the foot from side to side and forcible bending of it downwards, the non-articular part of the upper surface of the os calcis comes into view (Fig. 291). A groove is now cut through the fatty tissue and the periosteum, and the saw applied just in front of the tendo-Achillis, vertically downwards (*vide* Fig. 291), care being taken to bring it out through the incision in the heel. The foot being removed, the soft parts around the bones of the leg are carefully cleared to a level just above the tibial articular surface and the malleoli, where the saw is next applied, and the bones divided transversely.

FIG. 291.



Division of the os calcis in Pirogoff's amputation.

FIG. 292.



Pirogoff's amputation as modified by Dr. E. Watson. (Smith and Walsham.)

The vessels, the tibials, anterior peronæal, and perhaps one or both malleolar having been secured, the tendons cut square, the bony surfaces are placed in contact, and, if needful, drilled with a sterilised bradawl and united with wire or stout chromic gut.*

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* If the patient is young and healthy, this step is not absolutely needful. I would recommend it in other cases. Thus I have made use of it in a Pirogoff's amputation for inveterate infantile paralysis, with excellent results. If wire be used, it must be left long. A little ether will probably be needed when the wire is removed.

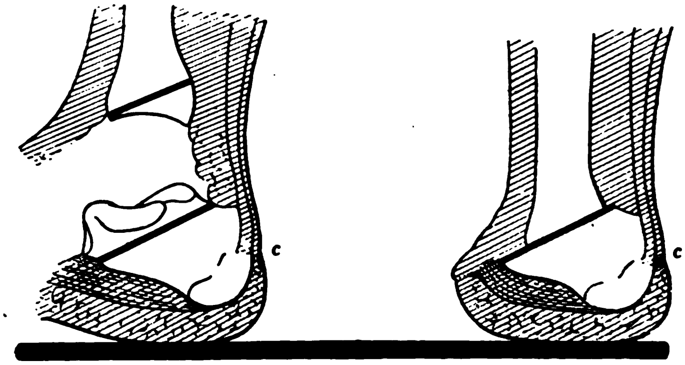
If it is found advisable to convert the Pirogoff into a Syme, all that is needed is to divide the tendo-Achillis and to dissect out the part of the os calcis, keeping the knife close to the bone.

Modifications of Pirogoff's Amputation.—One of the chief of these is that introduced by **Dr. E. Watson** (*Lancet*, 1859, vol. i. p. 577). He claims—(1) That it is shorter and easier, the trouble of disarticulation being avoided. (2) That it is less likely to damage the posterior tibial artery. (3) That it does away with one of the chief difficulties in a Pirogoff's amputation for injury—viz., the want of purchase over the smashed parts while the os calcis is being sawn through.

Operation.—The operator, standing as before, having cut across the sole from the tip of one malleolus to the corresponding point (p. 692) down to the bone, introduces a small Butcher's saw, or one with a narrow blade, into this wound, and saws off the posterior part of the os calcis by carrying his section upwards and backwards. This and the heel being now retracted by an assistant (Fig. 292), the surgeon, resuming his knife, cuts upwards behind the ankle-joint between the sawn bones. The ends of the first incision are now joined by one passing between them, the skin being pulled up a little and the tendons and vessels severed down to the tibia and fibula just above the ankle-joint. Lastly, these bones are sawn through in a slanting manner by directing the saw from before backwards and downwards.* While the bones of the leg are being sawn, the heel-flap should be held well up against the back of the leg to keep it out of the way.

Modifications by Sédillot, Gunther, and Le Fort.—It is obvious that if the bones are divided as advised by Pirogoff—*i.e.*, the os calcis vertically downwards and the tibia and fibula transversely—the patient, when the bones are united, will come to walk, not upon the thick fibro-fatty cushion under the tuberosities of the os calcis, but upon the thin skin over the insertion of the tendo-Achillis. To obviate this **Sédillot** and **Gunther** have advised the very oblique section of the bones shown in Figs. 293 and 294. **Pasquier Le Fort** goes still farther and saws

FIG. 293. FIG. 294.



Modifications of Pirogoff's amputation by Sédillot and Gunther. (Farabeuf.

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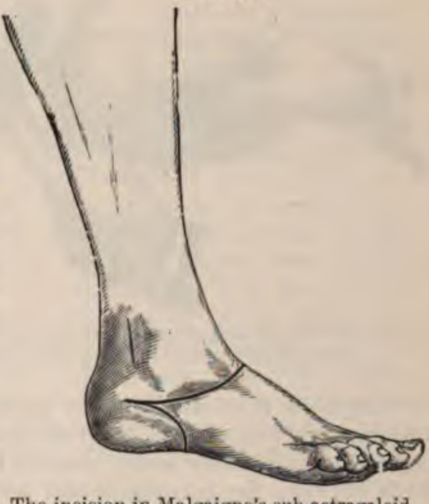
* It will be noticed that the direction of the bone section above given by Mr. Watson is contrary to that usually taught.

through the os calcis, horizontally, parallel to its articular surface, the bones of the leg being also sawn horizontally. Sir W. Mac Cormac thus describes the chief steps of the operation, *Surg. Oper.*, pt. ii. p. 237. The incision in the soft parts is commenced three-quarters of an inch below the external malleolus and continued forwards as far as the anterior third of the calcaneum. Having reached this point the knife describes a curve, across the dorsum of the foot, whose anterior convexity corresponds to the astragalo-scaphoid articulation. When the knife reaches the inner border of the foot it is made to pass backwards, and stops one inch in front of and below the inner malleolus. A slightly curved plantar flap is then made, which passes transversely across the sole of the foot and rejoins the first incision below the external malleolus. The tibio-tarsal joint having been next opened, the upper margin of the os calcis is exposed and the saw made to traverse the bone horizontally forwards. The remaining connections are then divided.

SUB-ASTRAGALOID AMPUTATION (Figs. 295–297).

This operation consists—the soft parts being divided as at Fig. 295 or 296—in opening the astragalo-scaphoid joint from the dorsum, and the astragalo-calcanean of which the interosseous ligament can only be divided by introducing the knife point from the outer side. The whole foot is then removed in one mass with the exception of the astragalus, which is left mortised in between the tibia and fibula. When the stump is healed, this bone should rest upon the ground by its inferior surface. If, however, the stump should be pulled up by the tendo-Achillis and other cut muscles taking on a firm attachment, it will be the head of the astragalus alone which will rest upon the ground and transmit the weight of the body. While this has the advantage of diminishing the shortening of the limb, it has the grave inconvenience of narrowing the basis of support, and of bringing the weight of the body upon that part of the stump where the cicatrix is necessarily found.

FIG. 295.



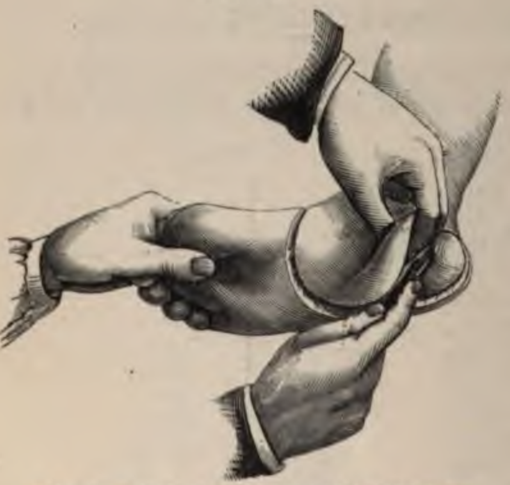
The incision in Malgaigne's sub-astragaloid amputation. (Mac Cormac.)

This amputation, very rarely practised in England, has, with that of M. Tripier (p. 715), largely replaced that of Chopart in France. The majority of English surgeons have, I believe, had reason to be satisfied with Chopart's amputation, in spite of the objections brought against it (p. 713). The following account is taken from Dr. Stimson, *Man. of Oper. Surg.*, p. 113:—

"The guides to this operation are the tip of the external malle and the head of the astragalus. The joint must be entered from in front on the fibular side, and the strong interosseous ligament which forms the key to the articulation must be divided, step by step, from before backwards and inwards. The posterior tibial vessels must be carefully avoided.

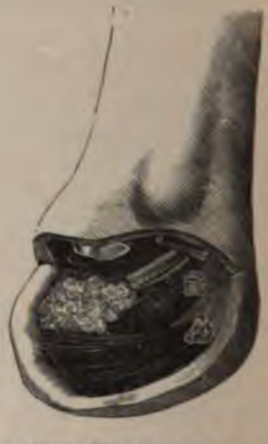
"Beginning at the outer side of the heel nearly one inch below the tip of the external malleolus, an incision extending through to the bone is carried straight forward to the base of the fifth metatarsal bone, thence curving forwards across the dorsum of the foot to the base of the first metatarsal, thence obliquely backwards and outwards across the sole of the foot and around its outer border, rejoining the first horizontal part of the incision at the calcaneo-cuboid joint. The soft parts must be separated from the outer surface of the calcaneum and cuboid with division of the peronæal tendons, the dorsal flap dissected back to the head of the astragalus, and, on the inner side, beyond the tubercle of the scaphoid, thus dividing the tendon of the tibialis anticus and the anterior portion of the internal lateral ligament. The interosseous ligament can then be easily reached by depressing the toes, passing the knife between the astragalus and scaphoid, and cutting backwards and inwards along the under surface of the former. The soft parts on the inner side are then separated from the calcaneum, injury to the vessels being avoided by keeping close to the bone between it and the tendons of the flexor communis, the foot depressed, and the tendo-Achillis divided. This last is a very difficult part of the operation, and great care must be taken to keep the edge of the knife close to the bone so as not to cut through the skin. The posterior tibial nerve should be dissected out and cut off as high as possible, so that it shall not be pressed upon in the stump."

FIG. 296.



Sub-astragaloid amputation (right foot) by large internal and plantar flap. (Farabeuf.)

FIG. 297.



Sub-astragaloid amputation (left foot) by large internal and plantar flap. (Farabeuf.)

M. Farabeuf advises an internal and plantar flap, whose nutrition is guaranteed by a very large base. This is the flap of Roux (Figs. 285, 286), made considerably longer in front. The incision passes parallel to the outer border of the foot, a full finger's-breadth below the external malleolus, as far as the tuberosity of the fifth metatarsal, then across to the scapho-cuneiform articulation, and the extensor proprius pollicis tendon. Then it descends over the middle of the inner border of the foot, as far as the centre of the sole. Here it begins to turn back along the outer border of the foot, as far as the posterior extremity of the os calcis, where it joins the starting-point. Fig. 296 shows the dissection of this flap in the case of the right foot: the left hand of the operator raises and protects the soft parts in front of the knife, which is kept parallel to the vessels and tendons lying under the sustentaculum tali. Fig. 297 shows the flap before it is sutured.

EXCISION OF THE ANKLE.

This operation is one of very disputed value, and thus rarely performed. *Objections:* (1) Disease here is often associated with disease of the tarsus. (2) Even if the wound heals, the foot left is often of little use. (3) Syme's amputation affords not only a radical cure, but a most excellent stump. This may be imperilled by a previous excision of the joint.

Indications.—These, which are very few, must be considered separately, according as they fall under the heading of: A. *Disease.* B. *Injury.*

A. *Disease.*—(1) The patient must be young and healthy, with no evidence of other tubercular disease, or of phthisis or syphilis. (2) The disease should be of traumatic origin—*e.g.*, following a sprain—and (3) limited to the bones which form the joint, the whole astragalus being taken away if needful. To another class of cases in which this operation has been too often performed—viz., where the patient's health is reduced by discharge, pain, hospital air, &c., where other tarsal bones are involved—this excision is not applicable; it is here much severer than amputation, and leaves the patient most liable to recurrence.[*] Quite a separate instance of excision in disease may be occasionally practised in advanced cases of infantile paralysis. Here the ankle may be excised (by a transverse incision) some time after the knee has been submitted to the same operation, in order to give a firm basis of support in good position, instead of a flail-like limb which shuts up at the knee and ankle (p. 638).

The chief points in excision of the ankle-joint which have been raised as objections to the operation are: (1) The difficulty of free exposure of the parts to be dealt with; (2) The frequency with which other bones are diseased. Thus Mr. F. Jordan[*] strongly objected to the operation on the ground that the astragalus is not a long bone with an epiphysis in which the chief disease may lie, but a short bone consisting of a mass of cancellous tissue throughout which the disease is more or less diffused. This objection may be answered by the fact that if the disease in the astragalus is found not to be limited to the upper articular surface, it will in no way interfere with the results if the whole bone is removed.[†] And this fact will meet another objection to excision of the astragalus made by Prof. Syme—viz., that the frequency with which disease of the astragalus originates on the under surface of this bone (*i.e.*, between it and the os calcis [‡]) calls rather for amputation than excision. (3) The difficulties of securing afterwards a splint which will combine the three following essentials—viz., (*a*) Sufficient rest; (*b*) Sufficient exposure for needful change of dressings; (*c*) The possibility of antiseptic treatment. Two excellent but too little known splints are Esmarch's bracket-splint, and the iron splint moulded to the back and front of the leg, and front and sole of foot, and covered with india-rubber, introduced by Mr. Paul of Liverpool. This is a model of combined usefulness and simplicity. Both are secured in place with plaster of Paris. But if, in addition to much of a cavity to fill up, any tendency to œdema remains, a back and two side splints—all three being interrupted—are, in my opinion, preferable.

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[*] In Mr. Holmes's words (*Syst. of Surg.*, vol. iii. p. 766), in the first class of case "the inflammatory softening or suppuration does not usually extend far from the neighbourhood of the joint originally implicated, and, after the removal of the diseased bone, the parts take on a healthy action and become rapidly consolidated, In strumous disease, on the other hand, inflammatory softening, if not diffused suppuration, often exists in the tarsal bones or bones of the leg in parts not exposed to view in the operation; and, in patients labouring under general constitutional affections, the parts operated on, instead of consolidating, usually soften, and after a long and exhaustive suppuration the bones are found carious, leaving no resource except amputation, and that sometimes under unfavourable circumstances."

B. *Injury.*—In a young, healthy patient, where the vessels and nerves are mainly intact, where the mischief is limited to the ends of the bones, an attempt to save the limb by excision, partial or complete, is abundantly justified. The steps given at p. 679 for the antiseptic treatment of compound fractures should be carefully attended to, as to the preservation of periosteum, the due providing of drainage, etc. As to gunshot injuries, Dr. Otis (*Med. and Surg. Hist. of the War of the Rebellion*, pt. iii. p. 610) thought that "the substitution of excision of the ankle-joint for amputation effected no saving of life," formal excisions being rarely successful.

Operation.—This may be either by two lateral incisions, or by a transverse one, dividing the extensor tendons, which are sutured afterwards.

Excision by Lateral Incisions.—An Esmarch's bandage having been applied above, and the parts rendered evascular as well, the foot is laid upon its inner side firmly supported on a sand-bag. An incision is made along the lower two and a half inches of the posterior border of the fibula, and then, when it has reached the tip of the malleolus, it is carried downwards and forwards at an angle to within an inch of the base of the fifth metatarsal bone. A slight flap is now sufficiently dissected forwards to expose the bone and to clear the peronæi; these being drawn aside, the bone is divided with a narrow saw or cutting-forceps about two inches above the malleolus, and removed after division of the external lateral ligament. This wound is now covered with sterile gauze, the foot turned over, and a similar angular incision made along the lower two inches of the inner margin of the tibia, and then forwards and downwards as far as the projection of the internal cuneiform bone.* A flap being dissected slightly inwards, the tendons of the tibialis and flexors are exposed and retracted,† the knife being kept close to the bone so as to avoid the posterior tibial vessels.

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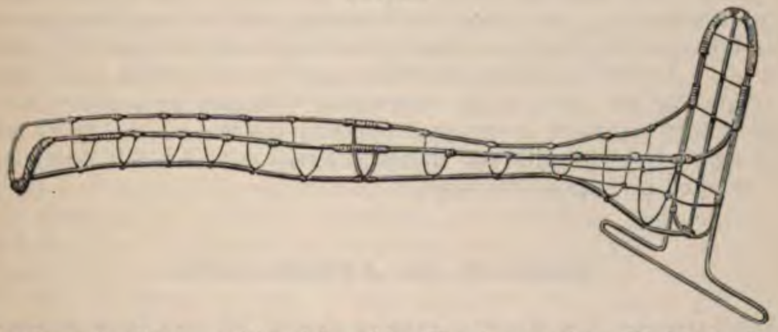
[*] *Lancet*, 1897, vol. i. p. 729.

[†] Mr. Holmes, whose experience of this operation is a large one, advises (*Brit. Med. Journ.*, 1878, vol. ii. p. 875) that the whole of the astragalus should always be removed. for these reasons—(1) As it is often softened to a considerable depth, mere removal of its articular surface will often leave disease behind; (2) in patients low in health. or of strumous constitution, the violence done by the saw may prove the starting-point of renewed caries; (3) the bones of the leg unite quite as firmly to the exposed cartilaginous surfaces of the os calcis and scaphoid as they do to the sawn surface of the astragalus; (4) the shortening is not appreciably increased; (5) the difficulty of the operation is lessened.

[‡] Instances of extensive removal of the bones of the tarsus are given at pp. 706, 707.

The internal lateral ligament is now cut through close to the tibia, and on displacing the foot outwards the tibia and astragalus present in part at the inner wound. A metacarpal saw being next passed from the inner to the outer wound, the lower end of the tibia is sawn off sufficiently high up to secure a healthy section of bone, and no more. The astragalus is next treated similarly,‡ all the articular cartilage being removed. Any soft patches of bone are next gouged out, and pulpy material snipped away from the synovial sheaths of the tendons, &c. All sinuses are next scraped out or laid open. The only vessels which will require tying are some branches of the peronæal and the malleolar, none of any importance being divided. Very few, if any, sutures should be used, so as to allow of very free drainage.

FIG. 298.



Mac Cormac's splint for excision of the ankle. The shape can be modified by bending the wire, and the limb immobilised by plaster of Paris (Mac Cormac).

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* The lower extremities of these incisions need not go down to the bones.

† Unless these tendons are sufficiently freed from their connection with the lower end of the tibia, difficulty will be met in everting the foot sufficiently to bring the tibia out of the wound (Hancock, *Lancet*, 1867, vol. i. p. 731).

‡ If the disease here is at all extensive, this bone should be entirely removed (p. 698). If a section only of the astragalus is taken, much difficulty will be met in removing the upper articular surface. Thus, unless the saw be directed properly, the astragalo-scaphoid or astragalo-calcanean joints may be opened. To meet the difficulty of fixing the foot the heel should be held in the left hand, and the upper surface of the astragalus is pressed against the cut end of the tibia, while an assistant holds the leg firmly on, and a little over, the edge of the table (Porter, *Brit. Med. Journ.*, 1878, vol. ii. p. 792).

Excision by Transverse Incision.—The parts being rendered evascular, an incision is made transversely across the front of the ankle-joint from the tip of one malleolus to the other. The extensor tendons being divided, the anterior and lateral ligaments severed, the end of the tibia is exposed, a way cleared for the saw just above the malleoli, and a slice removed. The upper articular surface of the astralagus is then treated in the same way, the peronæi and flexor tendons being drawn aside while the bones are sawn. Any dead bone is gouged away and pulpy tissue removed, as mentioned above. Hæmorrhage having been arrested, the divided tendons are sutured with carbolised silk.

In either of the above operations every care must be taken to preserve the periosteum, especially where this is softened and loosened.

A suitable splint is always a difficulty in these cases. On the whole, a back-splint and foot-piece, and two side-splints, all being padded with gauze, will be found most suitable for the first ten or fourteen days; the side-splints, being secured with straps and buckles, readily admit of removal so as to change the dressings. If all the disease has been taken away, and due drainage provided, the dressings will need changing very infrequently. After the first fortnight, the limb may be put up in one of Esmarch's, Paul's, or Mac Cormac's splints, secured with plaster of Paris. Another arrangement which answers well with a quiet patient is to put up the limb on its outer side, with the knee flexed, on an outside angular splint interrupted opposite the wound, the splint being duly supported with pillows. If the external wound is left freely open, this method gives good drainage.

ERASION OF ANKLE-JOINT.

Indications.—The above operation should be employed when the following conditions co-exist: A young subject with good power of repair; tubercular disease limited to the ankle-joint; absence of disease in other joints or viscera. Where these conditions do not coexist, a Syme's amputation is in my opinion to be unhesitatingly preferred, owing to the excellent stump which it gives; where disease has been left here too long, and where the tibia is involved, and the soft parts undermined and riddled with sinuses, and the tendon sheaths involved high up, an amputation of the leg may be required.

Erasion of the ankle-joint will obviously be of limited use, as in many cases several of the tarsal bones are involved in addition to the ankle-joint, and when the subject is not young, failure of an erasion or excision of the ankle-joint imperils greatly the success of a Syme's amputation.

Operation.—As in excision of the ankle-joint the different methods class themselves under two heads: (A) **A transverse incision.** (B) **Lateral incisions.** (A) **Erasion by a transverse incision.**—G. A. Wright, of Manchester, who gave such a healthy impetus to erasion of joints, thus describes a case operated on as long ago as 1882 (*Diseases of Children*. Ashby and Wright, p. 633):

> The child was 8 years old. The joint was opened by a transverse incision across the front of the joint, dividing all the extensors, &c., much pulpy synovitis existed with subchondral caries; all the pulpy tissue, as well as the loosened cartilage were

removed as far as possible. The tendons were stitched together with catgut and the wound closed. No attempt was made to unite the nerve, the anterior tibial artery was twisted. The wound was very slow in healing, but three years later the child's condition was as follows: "foot sound and well, but the toes are somewhat pointed, and he 'throws' the foot in walking. He gets about well with a boot and without any support. A good deal of new bone-formation about line of incision, but some mobility."

Mr. W. A. Lane has extended the above method by a transverse incision, as follows (*Clin. Soc. Trans.*, vol. xxvii. p. 15): "An incision is made from the anterior margin of the tip of the inner malleolus across the front of the ankle, then backwards immediately below the external malleolus around the heel to within a measurable distance of the flexor longus hallucis, everything being divided down to the bone. The only structures about the ankle-joint which are left uncut are the internal lateral ligament, the tendons of the flexor longus digitorum and tibialis posticus, the posterior tibial vessels and nerve, and the superjacent connective-tissue and skin. The interior of the ankle-joint can then be exposed as readily as one separates the pages of a book, and the whole of its synovial membrane exposed. The narrow prolongation of synovial membrane upwards between the tibia and fibula is shown more completely by dividing the inferior interosseous and anterior tibio-fibular ligaments." Some care is required in putting up the limb in plaster after the operation, that the fibula does not fall back a little from its normal position. Finding that union of the divided tendons is not satisfactory, Mr. Lane (*Clin. Soc. Trans.*, vol. xxxii.) now divides the peronæi only, and at some distance above the joint. The other tendons are exposed for some distance and drawn aside.

(B) **Erasion by Lateral Incisions.**—Mr. Clutton, believing that such a very free division of the structures around the ankle-joint is not necessary in erasion, has recently advocated this method (*Trans. Med. Chir. Soc.*, vol. lxxvii. p. 101). "The method * of procedure was by a series of vertical incisions round the ankle-joint, through which a sharp spoon, and even a finger, could be introduced. Four incisions, one in front and another behind each malleolus, avoiding ligaments and tendons by freely opening the joint, were generally employed. If traction was made on the foot the finger could always be introduced to examine the joint surfaces after the use of the sharp spoon. The nozzle of an irrigator with a full stream of aseptic fluid was kept constantly going through one or other of the openings round the joint. The introduction of the finger was especially useful in hunting for soft patches of tubercular granulation-tissue, for then the sharp spoon could be introduced to that spot. In most cases the cartilage came away and the bone beneath was attacked with more or less vigour, according to the condition of the fragments which were removed. An objection has been raised to this method of procedure, namely, that the surgeon cannot see the condition of the structures upon which he is operating. But if the finger is used as described above, and when the bone is being scraped, the fragments are carefully examined, there is really little difficulty in arriving at a conclusion as to when enough has been done. The consistence of the bone and its resistance to the action of a sharp spoon is not alone sufficient, for in the neighbourhood of a diseased articulation the bone is often rarefied without being invaded with tubercle." A copious dressing was applied, and over this a plaster-of-Paris splint was put on with an iron bar at the back, and windows at each side. When the patient was able to get up, a knee-rest was ordered to be used for many months.* Any persistent sinus must be scraped out without delay (p. 647).

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* As stated by Mr. Clutton, an exactly similar method of operating is described by Bruns (*Münchener Med. Woch.*, 1891).

Mr. Clutton gives six cases which have been treated by him by erasion with longitudinal incisions. As to the results Mr. Clutton is certainly correct in claiming that they "are sufficiently encouraging to make one think that more effort should be made in the conservative treatment of the joint than appears at present to be the practice of operating surgeons."

As to which of the two methods is the best it is clear that good results can be secured by either. Speaking for myself only, I am of opinion that in most hands a transverse incision, prolonged as freely as needful, will give the best exposure of the joint, and thus facilitate the eradication of all the diseased tissue which is so essential in dealing with tubercular joints (p. 639).

EXCISION OF BONES AND JOINTS OF THE TARSUS.

Before considering these separately, I would invite attention to the following **practical points:**

i. Those cases are the least hopeful in which there is no history of injury, in which there is evidence of a tubercular constitution, or perhaps of disease dating to an exanthem and coupled with the above constitution; cases in which the patient is wan and sickly with long lasting pain and sleeplessness; cases in which the parts are much swollen, dusky red, and glossy, with sinuses numerous or excavated, giving vent to watery, ill-smelling discharge—all points denoting a disease that is not limited to one joint or to few bones. ii. Mere laying open, and, still more, injection, of sinuses where there is disease of the tarsus is absolutely useless in most cases. iii. When a patient is under care for caries of the foot, his lungs should always be carefully examined before operative treatment is undertaken. iv. When the amount of disease present is being estimated, it must be remembered that patients, especially children, will often use their feet with much freedom, limping, even bearing their weight on their toes with the aid of a crutch, though all the time extensive disease is present. v. That before an operation, the parts should always be rendered absolutely evascular by the use of Esmarch's bandages,† and that thus the limit of the disease should be defined as accurately as possible. vi. Sub-periosteal excision is only advisable in the case of single bones where the periosteum is already thickened and loosened, and that in other cases it is not of such great advantage as to justify any considerable prolongation of an operation. vii. Strict antiseptic precautions should be made use of wherever this is possible, because—(*a*) Prolonged suppuration will exhaust a patient whose powers are already sufficiently handicapped by disease and operation; (*b*) Suppuration will cause destruction of the periosteum, and thus fresh caries and necrosis; (*c*) Interference with inflamed bones may, if sepsis result, easily cause osteo-myelitis and pyæmia. viii. When the question arises between excision and amputation, if the powers of repair have been duly considered, the question of time and the rank of life should also be remembered. Thus, after an extensive excision, six months will probably be required before the foot can be used, but only three months after an amputation. The time in the first case may after all be wasted, a point of much importance, when the question of schooling, learning a trade, &c., have to be considered. ix. No use of a foot can be permitted after an operation till firm consolidation is obtained. x. If pulpy mischief persist after an operation, the sharp spoon must be freely used, together with laying open sinuses, snipping away of undermined skin, &c. If all carious bone has been removed, the above steps may be repeated again and again here, as in the knee, with ultimate success.

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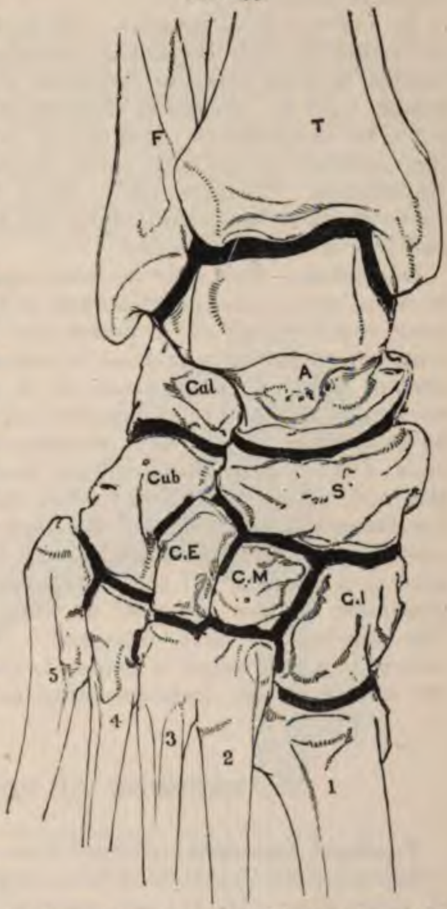
* Free movement in the medio-tarsal joint often made up for any ankylosis of the ankle-joint.

† This is disputed by some. I strongly advise it. The free oozing after this method may be met by tying any vessels which are seen in the absolutely dry wound, and then usually plugging this with strips of iodoform gauze, wrung out of carbolic-acid lotion. 1 in 20, bandaging firmly over well-applied dressings before the Esmarch's bandage is removed, and giving sufficient morphia in the first twelve hours. This dressing will seldom require removal for several days, when the strips must be thoroughly soaked before removal.

FIG. 299.



To show the arrangement of the tarsal synovial membranes. (Mac Cormac.)

EXCISION OF THE ASTRAGALUS.*

Indications.—These will be for A. *Disease*, B. *Injury*.

A. *Disease*.—(1) Caries of the bone, especially when comparatively recent and of traumatic origin in a young and healthy patient, and when the disease is found to be limited to the upper surface. (2) In disease of the astragalo-calcanean joint, where it is thought, from the position of the sinuses, &c., to be more advisable to expose this joint by removing the astragalus than the os calcis. (3) Talipes: in inveterate resistant cases (p. 711).

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* A good instance of the occasional value of this operation has been given by my old friend George A. Wright (*Pendlebury Abstracts*, 1884, p. 124). The case was one of

B. *Injury.*—(1) Primarily. (*a*) In simple dislocation of the astragalus not reducible with the aid of anæsthetics and tenotomy of the tendo-Achillis and the tibials or extensors, if it seem certain that the skin will slough. (*b*) In compound dislocation of the astragalus when the bone is too far displaced or comminuted to admit of replacement, and when the condition of the soft parts, vessels, and tendons does not call for amputation. (2) Secondarily, when the foot is useless and painful. In these cases, especially, strict antiseptic precautions must be taken and free drainage provided.

Operation.—This may be performed by two lateral or a transverse incision, with subsequent suture of the tendons. On account of the freer exposure given, I prefer the latter. The parts having been rendered evascular, the bone is exposed by an incision crossing the dorsum between the malleoli, as in Syme's amputation; the tendons are cleanly cut, and the astragalus exposed. At this stage all that may be required is to remove a sequestrum from the upper surface of the neck of the bone. The ligaments must be divided by carefully keeping the knife close to the bone * while this is twisted out in the grasp of lion-forceps, aided, if needed, by the levering movements of an elevator, care being taken, in using this, not to bruise any soft bone which is used as a fulcrum. If the astragalo-calcanean joint is found diseased, this must be now attended to with chisel, gouge, and sharp spoon. The scaphoid is next examined. All pulpy material having been removed, hæmorrhage is arrested, the tendons carefully sutured, and the wound closed, drainage being provided if necessary.

EXCISION OF THE OS CALCIS.

Practical Remarks.—Disease here is not very infrequent, and often remains limited to this bone for a long time. It may commence in one of three sites—viz., (*a*) the posterior epiphysis, which, not appearing until the tenth year, does not unite till between the fifteenth and nineteenth years; (*b*) the body of the bone; (*c*) the calcaneo-astragaloid joint, either *de novo*, or as an extension of the last. The diagnosis of primary disease in this joint is often difficult; thus the swelling and

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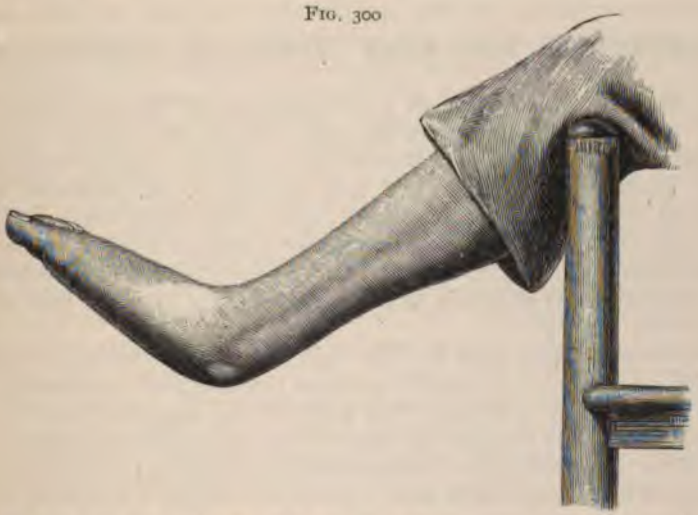
severe talipes valgus, due to infantile paralysis of a year's standing. The reaction of the muscles to faradism was extremely poor. "The deformity clearly depended on a partial sub-astragaloid dislocation." The bone was removed by an incision along the inner border of the tibialis anticus, and a shorter one meeting this between the tibialis anticus and posticus. No tendons were cut; one small vessel required twisting. The foot could be inverted into good position after removal of the bone. Twelve months later the child could walk painlessly and much more freely, without eversion, and with a good arch.

* Especially at the back and on the inner side.

position of the sinuses recall disease of the ankle-joint. The pain is usually greater than in ordinary disease of the os calcis itself, and the foot is sooner disabled. With an anæsthetic, the ankle-joint is found free, and probes introduced by sinuses may pass towards the level of the upper surface of the os calcis (known by the tubercle for the extensor brevis).

Operation.—The parts being rendered evascular and the foot firmly supported on its inner side at the edge of the table, an incision* is made with a strong-backed scalpel, commencing at the inner edge of the tendo-Achillis, and passing along the upper border of the os calcis (*vide supra*) at the outer border of the foot as far as the calcaneo-cuboid joint, which lies midway between the outer malleolus and the fifth metatarsal bone. This incision should go down at once upon the bone, so that the tendon should be felt to snap as the incision is commenced.

FIG. 300



Foot two years after removal of os calcis in a child. The foot is flat but very serviceable. As will be seen from the state of the calf, the tendo-Achillis has taken on a fresh attachment in the detached periosteum, and has been well employed.

Another incision is then to be drawn vertically across the sole, commencing near the anterior end of the first, and terminating just short of the inner surface of the os calcis, beyond which it should not extend for fear of wounding the posterior tibial vessels. The bone being now exposed by throwing back the flap, the calcaneo-cuboid joint is first found and opened. The peronæi must be dissected out,* and drawn aside with a blunt hook. The astragalo-calcanean joint is next attacked: and the close connection between the bones at this point constitutes the principal difficulty of the operation, unless the ligaments have been destroyed by disease. This difficulty can best be met by grasping the bone firmly with lion-forceps, and wrenching it backwards and outwards, aided by levering movements of an elevator, and a knife-point kept very close to the bone. Especial care must be taken on the inner side to avoid the vessels. The bone being removed, the gap is lightly plugged with gauze, and the dressings applied before the Esmarch's bandage is removed.

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* The above incision is taken from Mr. Holmes' article (*Syst. of Surg.*, vol. iii. p. 771). A still better one is that advised by Farabeuf (*Man. Opér.*, p. 759):—A horseshoe-shaped incision is made round the heel, beginning at the calcaneo-cuboid joint, dividing the tendo-Achillis, and ending on the inner aspect of the foot external to the posterior tibial vessels and nerves. To this incision a short vert one is added, running up along the outer side of the tendo-Achillis. By turning the flaps thus marked out the bone is most thoroughly exposed.

The question of preserving the periosteum has already been referred to, p. 703. Some good cases of excisions of tarsal bones are recorded by Mr. Holmes, *Syst. of Surg.*, vol. iii. p. 769 *et seq.*; and *Surg. Treat. of Children's Dis.*, chap. xxvi.

OPERATIONS FOR MORE COMPLETE TARSECTOMY.

It is scarcely worth while to give directions for the removal of other single bones—*e.g.*, the scaphoid and cuboid—as these are rarely diseased alone, and, if this should be so, their removal is easy.

The operations of Mickulicz and of Dr. P. H. Watson will be described to meet those cases where more extensive disease is present, and where the patient's age and condition justify a trial of these severe operations instead of amputation. In the very few cases which call for these operations Watson's is to be preferred, as it leaves a foot at right angles with the leg.

Operation of Mickulicz.†—The object of this operation is to procure an artificial pes equinus, and to preserve the toes and metatarsals, these being brought into a straight line with the leg, and the toes bent at a right angle, so that the patient walks on the ends of the metatarsal bones covered by the thick pads of tissue which invest them; a broader surface of support is provided than after Syme's or Pirogoff's amputations, and there is some elasticity of the foot left. I do not recommend this operation, and only introduce the account from my respect for the surgeon whose name it bears. The result is obtained at far greater cost and risk than that by a Syme's amputation, and is, in my opinion, of very doubtful superiority. Mr. Bland Sutton (*Lancet*, 1893, vol. ii. p. 1513) brought before the Medical Society the skeleton of a foot three years after the performance of Mickulicz's operation. The artificial pes equinus had been produced by Sir W. Mac Cormac in a girl, aged 18, the subject of infantile paralysis. In spite of the anatomical success of the operation the foot was of little service in progression, causing the girl much pain and inconvenience, and Mr. Sutton removed the leg by amputating through the knee-joint.

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* Mr. Holmes (*loc. supra cit.*) says that he has always divided these without ill ef[illegible]. Care must be taken in drawing them aside, for, if this is done too vigorously, [illegible] may slough, as happened to me in one of my cases.

† The account of this is taken from a paper of Sir W. Mac Cormac's (*Lancet*, May 5, [illegible]), [illegible] figures accompanying this. Mickulicz's paper will be found in Langenbeck's [illegible], [illegible], Bd. xxvi. S. 191.

Sir W. Mac Cormac's patient was aged 15, and the disease dated to a sprain of the ankle. On the lad's admission the swelling and sinuses pointed to disease of the os calcis; later on the ankle-joint became involved. Amputation being refused, Sir W. Mac Cormac operated thus: "The patient was placed in the prone position. If it be the right foot, the knife is introduced on the inner border of the foot, just in front of the scaphoid tubercle, and a transverse incision, extending to the bone, is made across the sole to a point a little behind the tuberosity of the fifth metatarsal. On the left foot the direction of this incision will be reversed. From the inner and outer extremities of the wound incisions are prolonged upwards and backwards over the corresponding malleolus, and their extremities united by a transverse cut across the back of the leg, down to the bone, at the level at which it is to be sawn, usually immediately above the joint surface of the tibia. In cases where a larger removal of the tibia and fibula is required, the lateral incisions must be more oblique, and the posterior transverse cut made at a higher level. The ankle-joint is now opened from behind, the disarticulation completed, and, after flexing the foot, the soft parts are carefully separated in front until the medio-tarsal joint is reached, through which disarticulation is effected as in Chopart's amputation. The heel portion of the foot, consisting of the astragalus, calcis, and the soft parts covering them, is thus removed. The articular surfaces of the tibia and fibula, with the malleoli, are now sawn off, as well as those of the cuboid and scaphoid. The anterior portion of the foot remains connected with a bridge of soft parts. The blood-supply appears to be ample, for almost directly after the operation blood issued freely from the distal ends of the divided plantar arteries. All hæmorrhage having been arrested, the foot was brought into a straight line with the leg, and the cut surfaces of the bone were sutured together with kangaroo tendon. The attempt to discover and unite the divided ends of the posterior tibial nerve failed, on account of the sodden condition of the soft parts. Suitable dressings and a plaster-of-Paris splint were applied, the toes being brought into a position of complete dorsal flexion."

The boy made an excellent recovery. Firm bony union took place. In about a month sensibility began to return in the sole, and gradually became more complete. The toes were mobile.*

Operation of Watson.—This is adapted to cases where the medio-tarsal articulation is involved, the importance of which, from the number of bones and the complicated synovial membrane, is well known (p. 717). In other words, the disease should be situated between the bases of the metatarsal bones in front and the os calcis and the astragalus behind. The parts being rendered evascular, incisions three to four inches long are made, on the outer side from the centre of the os calcis to the middle of the fifth metatarsal bone, and on the inner from the neck of the astragalus to the middle of the first metatarsal. The soft parts are carefully dissected off from the dorsal and plantar aspects of the foot by means of these incisions, the left thumb being kept between the point of the knife and the soft parts. With a curved probe-pointed bistoury the joints between the astragalus and scaphoid, and os calcis and cuboid, are opened up, and, a saw being passed between the plantar soft parts and the metatarsal bones, these are cut through from below upwards. The diseased bones being removed, the wound is firmly plugged and pressure applied with gauze pads and bandages before the tourniquet is removed. That this operation, though little known, is an excellent one in Dr. Watson's hands, is shown by the fact that five out of his six cases did well. It must be remembered that it is an operation in the dark, and one that may involve a good deal of damage to soft parts, owing to the amount of disease which has to be removed by somewhat limited incisions.

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* The patient was shown to the Medical Society more than a year after the operation. "He walked up and down the room, both with and without his boot
ease and evident satisfaction to himself. The union is quite solid,
attends to his daily work without any inconvenience."

REMOVAL OF TARSAL BONES FOR INVETERATE TALIPES.

Indications.—Cases which deserve the above epithet of inveterate, in which tenotomy, syndesmotomy, and forcible manipulation* have been thoroughly tried; cases in which there is evidently confirmed alteration in the shape of the bones—*e.g.*, in talipes equino-varus—such rigidity that the position of the foot cannot be possibly altered, the astragalus projecting outwards on the dorsum, and the scaphoid so displaced that it almost touches the internal malleolus; where the patient walks on the outer border of his foot, and large bursæ have formed over the cuboid; and where the patient is prevented from earning his livelihood. Finally, the surgeon must feel assured as to his power of conducting the case aseptically.

The chief **operations** for inveterate or resistant talipes are—(i) **Complete section either by open incision,** Phelps' operation, or by subcutaneous section; (ii) **Removal of the astragalus**; (iii) **Cuneiform tarsectomy.** Before they are described I would impress most strongly upon my younger readers the cardinal importance of the following: (1) Relapses will follow after any operation, however complete and severe at the time, unless the patient is kept under observation sufficiently long for the surgeon to feel certain that the case is cured. (2) Relapses depend either upon the patient being too soon removed from supervision, or upon the surgeon saying prematurely that the cure is complete. (3) No cure is complete until the patient has been walking, under skilled observation at intervals, for a sufficient time. It is quite impossible to lay down any law or limit here. For cases before puberty several years are required; for adolescents or adults at least one year is needed. The more severe the case the more care is required for the surgeon to be absolutely certain that, when walking is allowed, the body-weight falls on the foot in the right position, and not unduly on the outer side, perpetuating, if even in the slightest degree, the varus. (4) While there is no routine method of operation in these cases, the surgeon will, of course, secure the best results from that operation with which he is most familiar.

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* Either by the hands or by the aid of Thomas's wrench. An excellent account of the use of this—in fact, one of the very best descriptions of the treatment of talipes in the English language—is given by Mr. R. Jones, of Liverpool, and Dr. Ridlon, of Chicago, in the *Medical Annual* for 1896, p. 448. Another very helpful account of talipes is that given by Mr. Tubby in his recently published work on Orthopædic Surgery.

Phelps' Operation by Open Incision.*—The foot having been cleansed and rendered evascular is placed on its outer side, and a line is drawn from the tip of the inner malleolus to the tuberosity of the scaphoid. From the centre of this line an incision is made outwards across the inner third of the sole,† down to the neck of the astragalus on its inner side. Through this wound the plantar fascia, abductor hallucis, tibiales posticus and anticus, the long flexors, together with the internal lateral and calcaneo-scaphoid ligaments, are divided. If possible, the internal plantar vessels and nerve are spared. Great force is then used to rupture the deeper ligaments and over-correct foot. Phelps also divides the tendo-Achillis at the same time; others prefer to leave this step till a later occasion. The wound, partly sutured, is put up without drainage, and must heal partly under bloodclot, partly by granulation. The foot is maintained in the over-corrected position by plaster of Paris.

This operation has been modified in various ways in order to avoid the tendency to recurrence which results from the contraction of the scar left on the inner side of the foot.

Mr. W. A. Lane (*Lancet*, Aug. 19, 1893) puts on a large skin graft on the second day, in order to promote more rapid healing. Mr. T. H. Kellock (*Lancet*, March 30, 1895) partially fills the gap by means of a skin flap from the dorsum of the foot. Dr. W. Gardner, of Melbourne, quoted by Tubby (*Orthopædic Surg.*, p. 435), inserts a wedge of decalcified bone between the scaphoid and astragalus, "to which bones it is wired, and by this the lengthening of the inner side is maintained until the plate is replaced by fibrous tissue."

Finally, the following excellent modification is described by Dr. A. F. Jonas (*Ann. of Surg.*, April 1899, p. 449), and has been employed by him in twenty-five cases, with satisfactory results. Here a V-shaped flap is turned back while the structures beneath are divided; the flap is then replaced, the wound being sutured in the form of a Y.

The operation is described as follows: "An incision is made beginning slightly below the margin of the plantar fascia on the inner side of the foot, at a point on a line directly below and anterior to the internal malleolus, extending forwards and upwards to a point on the first metatarsal bone, and nearly to the metatarso-phalangeal articulation. A second incision is made beginning at a point over the astragalo-scaphoid articulation, extending forwards and slightly downwards, joining the first incision near the metatarso-phalangeal joint, forming a V. The incisions are made deep so as to include the subcutaneous tissue and fat. The flap is dissected backward to the points first indicated. We have now exposed all the shortened soft structures. We first sever diagonally the inner fasciculus of the plantar fascia. The diagonal division of the plantar fascia is done so that after correction there shall not be left a defect between the divided ends, but that the points of the incised fascia still come in contact, thereby lessening the tendency to contraction of this structure when repair is complete. The remaining structures are now divided successively as directed by Phelps, until the astragalo-scaphoid capsule is reached. Instead of dividing this, we make another incision on the outer side of the foot. over the head of the astragalus, pushing aside the tendons and soft structures and exposing the neck of that bone, and then cut through the neck with a chisel. We can now push the forward part of the foot outward without separating the astragalo-scaphoid articulation which nearly always occurs in the typical Phelps' operation." After bleeding has been arrested the wounds are closed and the limb put up in plaster of Paris.

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* Mr. E. Owen strongly advocates this operation in an excellent account of it (*Chir. Trans.*, vol. lxxvi. p. 89).

† Phelps originally made his incision two-thirds across the sole, but m owing to the tender scar which was liable to result.

Lane's* Complete Subcutaneous Section.—Mr. W. A. Lane, believing that the later results of Phelps' operation are very unsatisfactory owing to the "absolute loss of continuity of all the soft parts in the sole of the foot," advises the following method (*Lancet*, vol. ii. 1893, p. 432): "An india-rubber bandage is applied above the knee to control the circulation, so as to prevent the free bleeding that would otherwise occur, and then, by means of a strong, long-bladed, sharp-pointed tenotomy-knife, everything beneath the skin that opposes the placing of the foot in a position of moderate abduction upon the astragalus is divided. This includes the several divisions of the plantar fascia, part of the internal lateral and annular ligaments, the superior internal calcaneo-scaphoid, the inferior calcaneo-scaphoid and the long and short plantar ligaments, together with the tibialis anticus and all the tendons, vessels, and nerves in the sole of the foot. This cannot be done satisfactorily through a single puncture; but I do not hesitate to make any number of punctures, only taking care that the knife is entered in such a direction that the forcible fixation of the foot in a position of abduction does not cause the wound made by it to gape. This is a matter of considerable importance, since it is frequently necessary to sew up the apertures which are made by the knife, otherwise arterial blood spurts through them on removing the tourniquet. By spending some time, and by exercising a moderate amount of skill, it is possible to divide all the soft parts opposing abduction of the foot on the astragalus and to leave the skin intact, except for the punctures produced by the tenotomy-knife. After this has been done, I pass a knife between the skin and tendo-Achillis and divide it. If the foot does not become square I cut all the soft parts except the peronæi, carefully dividing the posterior ligament of the ankle-joint, which often opposes free movement of this articulation."

With regard to the above operations, I am of opinion that cases severe enough to require them are best met by cuneiform tarsectomy (*vide infra*).

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* A somewhat similar operation is given by Buchanan (*Brit. Med. Journ.*, Oct. 27 1888).

Removal of Astragalus (Lund, *Brit. Med. Journ.*, Oct. 19, 1872).—A longitudinal incision* about two inches long and gently curved, is made over the most projecting part of the head of the astragalus from the external malleolus downwards and inwards, between the outermost tendon of the extensor longus digitorum and the peroneus tertius. The soft parts on either side of the incision having been raised with an elevator, the ankle and astragalo-scaphoid joints are opened, the bone is loosened in its bed with an elevator while its ligamentous attachments are divided with blunt-pointed scissors. This is facilitated by drawing the bone in different directions with lion-forceps. The chief difficulties met with are: (1) the closeness with which the bone occupies its socket, and the consequent readiness with which, if a sharp instrument be used to lever out the astragalus, slices of cartilage are detached from the scaphoid or malleoli; (2) division of the ligaments, especially the interosseous and the internal lateral.

Advantages.—This operation gives an excellent result in those cases in which the chief cause of deformity is the astragalus. A good arch and much mobility at the ankle are often preserved.

Disadvantages.—In those cases in which removal of the astragalus is not sufficient to allow of the foot being placed at least at a right angle with the leg, the external malleolus must be partially divided with bone-forceps, and then the foot carried outwards, bending the malleolus backwards and outwards also (Walsham).† If this does not suffice a wedge must be removed from the tarsus. As I have not found it easy to make sure in which of these advanced cases removal of the astragalus will suffice, I generally prefer to remove a wedge at once, as involving less disturbance of the parts than two operations, and as being certain. Mr. Walsham, however, prefers beginning with removal of the astragalus. Mr. Ewens (*loc. infra cit.*) recommends tarsectomy.

Cuneiform Tarsectomy.—This operation is especially indicated in those inveterate or resistant cases of talipes where great prominence of the astragalus is not the prominent feature, where the fixity is too great to be overcome by the removal of one bone, or where this step has been used and failed. Personally, I prefer this operation in every case which is beyond the remedy of judiciously employed "wrenching." When I say in every case, I should like to make one reservation. I am referring to the bulk of cases which come before a hospital surgeon. Where these can afford time and expense, where the parents have the good sense to be patient over the time which is required to secure good results—in such cases milder methods will often suffice. But with the great majority of hospital cases it is not so. Time for schooling, apprenticing, and so forth, is urgently needed, perhaps much has been already lost. Even moderately expensive apparatus is difficult of attainment; intelligence and patience on the part of the parents or patient are, very often, not forthcoming; the regular attendance which is absolutely needful is broken off or interrupted, thus causing the inevitable relapses so well known to every surgeon of experience. Looking upon treatment here as mainly a question of time, not only to fit the patient to play his part in life's battle, but because the longer the deformity is left the worse is the habit of walking acquired, I generally resort to tarsectomy in patients as young as ten or eleven, and very occasionally even younger. I admit the foot is flat and shortened, and in some cases stiff, though this last is due to imperfect after-treatment and insufficient manipulation and active and passive exercise of the foot. *Though flat and shortened, the foot is square, without any tendency to inversion, after a well-managed tarsectomy.* This, I maintain, is the chief object before us in these resistant cases of talipes, and, as it is attained most speedily and certainly by tarsectomy, I recommend this operation strongly in poorer patients who can least afford to lose time.

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* G. A. Wright (*Diseases of Children*, with Dr. Ashby, [illegible]) advises an incision over the ankle-joint from the [illegible] [illegible] to the [illegible] and another incision at right angles to the line along the inner side of the tibialis anticus.

† "When once a [illegible] has been [illegible] on [illegible] the [illegible] till sufficient [illegible] has been cleared away [illegible] of the [illegible] of the foot. [illegible] of [illegible] so removed that a [illegible] [illegible] [illegible] the great toe." (*Ibid.*)

With regard to the matter of **age,** I would refer my readers to papers by Mr. Walsham (*Brit. Med. Journ.*, 1893, vol. i. p. 339) and Mr. Ewens, Surgeon to the Bristol Children's Hospital (*ibid.*, 1891, vol. ii. p. 843). Both these surgeons advocate resort to removal of bone at an earlier age than is usually allowed; both consider such operative steps justifiable, in special cases, in children only three years old. In Mr. Walsham's words: "I have not done a bone operation on these patients at a younger age than two or three years, but at that tender age I have found that, even after removal of the astragalus, the foot in some instances could not be got into a satisfactory position until further portions of the bones had been excised." Where, with the advantages of a well-ordered special department, skilled assistants and nurses, and ample experience, Mr. Walsham finds milder methods fail, other surgeons—working, perhaps, under less happy surroundings—need not fear to resort, in like occasional cases, to removal of bone.

Operation.—The parts having been rendered evascular with Esmarch's bandages, are duly cleansed and supported on a sand-bag. A T-shaped incision is then made with the horizontal limb along the outer side of the foot over the os calcis and the cuboid, and the longitudinal one at a right angle to this passing across the dorsum and ending over the scaphoid. The flaps thus marked out are turned aside. With a periosteal elevator the tendons and vessels in the dorsum are now raised so that sufficient room is given for the saw to pass between them and the bones. With a retractor on the outer side the peronæi tendons are held out of the way, due care being taken of their sheaths to avoid the risk of sloughing. With a narrow-bladed saw, a wedge of bone of sufficient size is then removed by two cuts, one above and one below, meeting at the scaphoid. The upper of these will pass through the os calcis to the scaphoid, the lower through the cuboid, through the joint between this and the fifth metatarsal, or through the base of this bone, according to the severity of the case. While these sections are made, a blunt dissector may be pushed under the bones very close to their plantar surfaces, so as to protect the soft parts beneath. The wedge of bone is then removed with a lion-forceps, or by levering it out with an elevator, care being taken not to damage any parts used as a fulcrum. As it is twisted out, a few attachments to the structures in the sole may require division or peeling off. If the position of the foot cannot be rectified, the gap must be widened by removing more bone either with a saw or with a chisel and mallet; it is especially towards the apex that this must be done.* When the foot can be brought into good position any tendons that have been divided are united with carbolised silk or chromic gut. Any vessels which can be seen are then secured, a drainage-tube is inserted, and the wound partly closed with sutures. Sufficient gauze dressings are then firmly bandaged on before the Esmarch's bandage is removed. The foot is put up with a back and two side splints, or on an external splint with an interruption, the knee being flexed and the limb resting on its outer side. Mr. Davy has devised a special splint to secure eversion. Morphia should be given freely at first if required. In six or eight weeks the union should be firm.

If after the operation the foot still turns in because the whole limb does so, osteotomy of the femur at about the junction of the middle and lower thirds should be performed, and the leg and lower fragment turned somewhat outwards.

Great care must be taken during the after-treatment to keep the parts aseptic. Mr. Davy lost one case, two weeks after the operation, from septicæmia (*Brit. Med. Journ.*, 1879, vol. i. p. 221). Œdema, &c., are of very likely occurrence, if, owing to an insufficient wedge being removed, much force has to be employed to correct the inversion. Occasionally complete closure of the wound is delayed by the coming away of a scale of bone; the ill-vitalised corns and bursal tissues may show some signs of sloughing.†

CHOPART'S AMPUTATION (Figs. 301–304).

In this medio-tarsal amputation only the astragalus and the os calcis are retained, disarticulation being effected through the joints between the above bones and the scaphoid and the cuboid.

Value of the Operation.—This has been a good deal disputed. The following objections have been raised to it:

1. That the tendo-Achillis, no longer counterbalanced by the extensor muscles, which have now lost their attachment, draws up the heel, tilting down the scar, which now becomes tender and irritable (Fig. 304). 2. In the normal foot the weight of the body is transmitted through the astragalus to the other bones of the tarsus and metatarsus. When, as in this amputation, these bones have been removed, the weight of the body tends to thrust forward the astragalus, no longer supported by the elastic bones in front, against the scar (Fig. 304), and thus renders this tender and crippling. The above objections apply to the operation performed for injury or disease, the next to amputation for the latter only. 3. If the operation be made use of in caries, this disease is likely to recur in the two bones left. In answer to the first two of the above objections it may be said that this tendency to tilting upwards of the heel and downwards of the scar may be met: (*a*) By stitching the anterior

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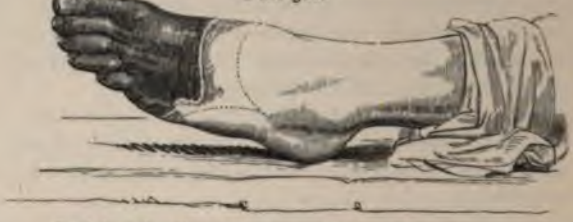
* Some contracted tendons may now require division before the inversion can be completely overcome. The tendo-Achillis may be divided now, or later.

† In a case of Sir. W. Bennett's (*Clin. Soc. Trans.*, vol. xv. p. 80) erysipelas attacked the sinus, which was all that remained of the wound, and all the union between the bones, which had become firm, gave way. The case ultimately did well.

tendons—*e.g.*, tibialis anticus, extensor proprius pollicis, and some of the tendons of the extensor communis—into the tissues of the sole-flap with stout carbolised silk or chromic gut, so as to give them a fixed point by which they may counterbalance the tendo-Achillis;* (*b*) by cutting the plantar flap sufficiently long, and securing firm primary union; (*c*) by division of the tendo-Achillis. This, however, is only of fugitive value; (*d*) wearing a wedge-shaped pad in the boot; (*e*) preserving the scaphoid, when sound, so as to retain the attachment of the tibialis posticus. "It has not been shown that this modification is of special value" (Treves).

FIG. 301.

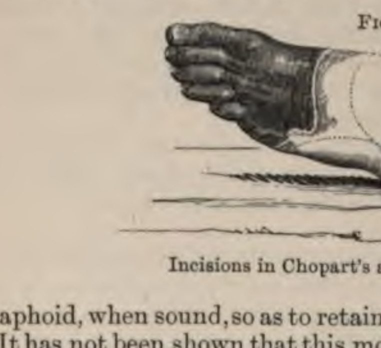


Incisions in Chopart's amputation. (Fergusson.) †

The third objection is answered by only performing this operation for caries when the disease is limited to the front of the foot, is of distinctly traumatic origin, and occurs in a healthy patient.

Operation (Figs. 301 and 302).—An Esmarch's bandage being applied, and the foot supported at a right angle over the edge of the table, the surgeon, standing to the right side of the foot, and so that he can easily face the sole, places (*e.g.*, on the right side) his left index and thumb immediately above the tubercle of the scaphoid and the corresponding point on the outer side—viz., the calcaneo-cuboid joint, which lies midway between the external malleolus and the base of the fifth metatarsal bone. He then joins these points by a slightly curved incision crossing the tarsus, and dividing everything down to the bones. The foot being flexed upwards, a plantar flap is then marked out by an incision running from the outer extremity of the first up the outer side of the little toe, then across the sole, and then down the inner side of the great toe to join the inner extremity of the first.‡ The flap

FIG. 302.



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* We owe this ingenious precaution to Mr. Delegarde, of Exeter. Till it is more frequently made use of, and a larger number of cases are collected, the value of this amputation must remain somewhat undecided. I have operated on five occasions—one a severe crush, another for the results of perforating ulcer, and in three for caries of the front of the foot; in all this precaution was taken, and the stumps proved sound and useful. One I have watched for four years.

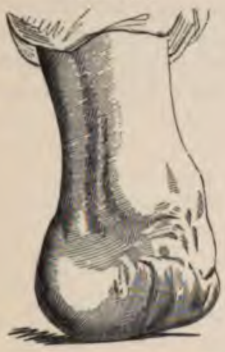
† Too much dorsal flap is shown here; the next figure shows the correct amount.

‡ The flap should be a full inch shorter than that in Lisfranc's operation (p. 718), if the tissues are sound. An unduly long and large plantar flap will here, as after a Lisfranc's amputation, form an unwieldy pocket (Treves).

thus marked out is raised with the same precautions given at p. 718. It is then held out of the way, and the anterior half of the foot being strongly depressed, disarticulation is effected by passing the knife above the tubercle of the scaphoid between this bone and the astragalus, and then between the concavo-convex surfaces of the calcaneo-cuboid joint. In effecting this the position of the joints and the shape of the astragalus must be remembered, and Mr. Skey's words borne in mind: "The joints should be opened with tact and not by force: if the knife be applied to the right surface, it will pass without effort into the articulation; if in the wrong direction, no force will effect it."

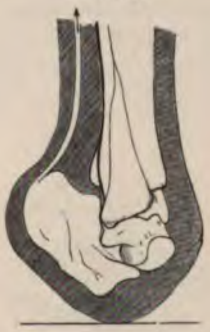
The anterior tibial and plantar arteries are then secured, and, on removal of the Esmarch's bandage, any other vessels which require it. The flap is then folded up over the bones, but without any forcible bending, which might interfere with the blood-supply. While it is held in this position, before any sutures are inserted, the extensor tendons (*vide supra*) should be carefully stitched with sufficiently stout silk into the fibrous tissues which abound in the plantar flap, care being taken, in so doing, not to puncture the external plantar vessels, but at the same time to secure a sufficient hold. The sutures inserted to hold the plantar flap *in situ* must be sufficient in number and stoutness, and must be retained till the flap is soundly healed.

FIG. 303.



Stump after Chopart's amputation. (Fergusson.)

FIG. 304.



Stump often met with after Chopart's amputation, showing its shape, the position of the bones, and the influence of the tendo-Achillis. (Farabeuf.)

TRIPIER'S AMPUTATION* (Fig. 305).

This operation was proposed by Dr. L. Tripier, of Lyons, as an improved modification of Chopart's amputation, over which it is thought to possess the following advantages: (1) The horizontal division of the os calcis on a level with the sustentaculum tali gives a large surface of support entirely free from the objections to that in Chopart's amputation (p. 713). Mr. Wagstaffe (*Lond. Med. Record*, 1880, p. 135) points out further advantages—*e.g.*, that less plantar flap is needed, and that the operator can see the state of the os calcis, amputating higher if this bone be too much diseased. The advantages of M. Tripier's amputation over the sub-astragaloid (p. 695) are: (i.) The limb is longer, (ii.) the section of the os calcis gives a larger and more solid basis of support. (2) By making the section of the os calcis, the tendons, especially the tendo-Achillis, are better preserved.

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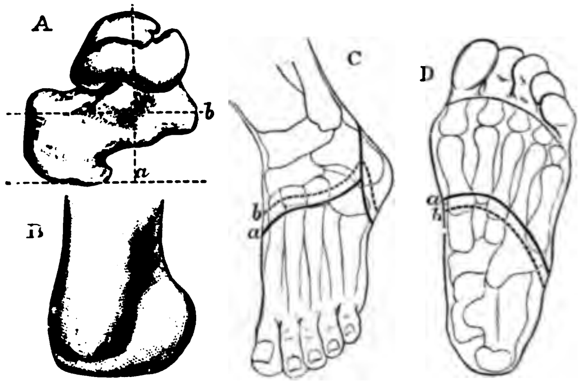
* A case of this amputation by Mr. Hayes, of Dublin, will be found in the *Brit. Med. Jou* ol. i. p. 303.

Plantar and dorsal flaps are marked out by the following elliptical lines, the dorsal starting from the outer part of the tendo-Achillis at its insertion, then passing about an inch and a quarter below the external malleolus forwards to a point about the same distance above the tuberosity of the fifth metatarsal bone; the incision then curves inwards to end at the inner side of the extensor proprius hallucis, over the tarsal end of the first metatarsal bone. From this point the plantar flap is marked out by an incision downward and forward over the inner part of the sole, about an inch in front of the base of the first metatarsal bone, and then obliquely across the bases of the metatarsals, and, lastly, backwards, so as to join the dorsal incision over the outer part of the os calcis. All the dorsal tendons are then divided along the line of the incision, and the structures in the plantar incision are cut down to the bones. A thick plantar flap is now raised until the under surface of the os calcis is exposed, and the point of the heel turned. Disarticulation, as for Chopart's amputation, is then performed. The periosteum covering the under aspect of the os calcis is now incised antero-posteriorly, and detached from the bone up to the level of the sustentaculum tali. The os calcis is next sawn through horizontally from within outwards, on a level with the same process. The projecting angles are then rounded off, and the plantar and dorsalis pedis arteries tied. As in all amputations, the nerve that will be in the flap that will bear pressure—i.e. the posterior tibial—should be trimmed short.

FIG. 305.



Tripier's amputation. *a*, Section through the skin. *b*, Through the soft parts. (Bryant.)

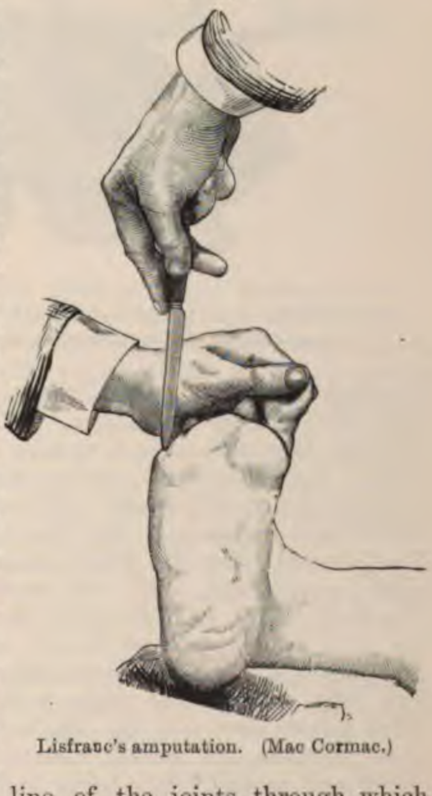
AMPUTATION THROUGH THE TARSO-METATARSAL JOINTS (Figs. 306-309).

This, though usually spoken of as Hey's or Lisfranc's amputation, includes, accurately speaking, the following **operations:** 1. **Lisfranc's.**—Amputation by disarticulation through all the joints. 2. **Hey's.**—This is usually described as amputation here by sawing through the bases of the metatarsals. In reality, Hey seems to have disarticulated through the outer four joints, and sawn off the projecting internal cuneiform (*Observations in Surgery*, third edition, p. 552). 3. **Skey's.**—Disarticulation through the outer three and the first joints, the second metatarsal being sawn through (*Oper. Surg.*, p. 406).

Indications.—Few. (1) Limited crushes in which the sole is sound. (2) Disease limited to the front of the foot. (3) Inveterate bunion, with persistent sinuses and recurrent attacks of cellulitis. (4) Perhaps perforating ulcer. (5) Some cases of frost-bite.

Owing to the complexity of the synovial membrane here (Fig. 299), any disease which has invaded the synovial membrane between the second and third metatarsals and the second and third cuneiforms, has also spread to that between the scaphoid and three cuneiforms. This, though of small moment in cases of injury, should put this amputation aside in most cases of disease.

FIG. 306.

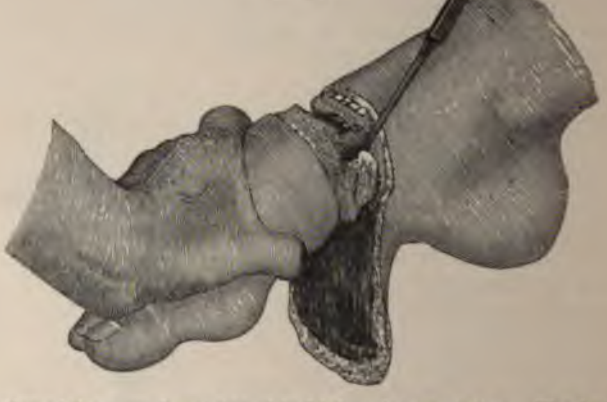


Lisfranc's amputation. (Mac Cormac.)

Lisfranc's Amputation (Figs. 306 and 307).—The preliminaries are the same as in Chopart's amputation. The surgeon, standing to the right side of either foot, and so as easily to face the sole, places his left index and thumb on the bases of the little and great toe metatarsals respectively. The first of these can always be found by pressure, even if swelling is present; if there be any difficulty with the latter, it will be found a full inch in front of the readily detected tubercle of the scaphoid. These two points thus marked out are joined by a slightly curved dorsal incision with its convexity forwards. As a rule, if the tissues in the sole are sound, no dorsal flap should be made, the above incision being kept close to the line of the joints through which disarticulation is to be performed.

The foot being now flexed upwards, the surgeon, looking towards [illegible] out a plantar flap by an incision running from the outer extremity of the first cut (for the right foot) up the outer side of the foot, then across the heads of the metatarsals, and down the inner side, so as to join the inner extremity of the dorsal incision. This flap should be made a little longer on the inner than on the outer side of the foot, so as to cover the additionally projecting bones on this side. Its cut edge being taken firmly between the finger and thumb, the flap is then dissected up as thickly as possible—*i.e.*, containing all the tissues possible in the sole. In keeping the knife close to the bones some of the metatarso-phalangeal joints will probably be opened. Below these the flap, if steadily pulled upon, will, with light touches of the knife, readily separate from the metatarsal bones. The flap should be raised evenly, and without scoring or any button-holes. The prominent bases of the first and fifth metatarsals being laid bare, a few strong touches of the point of the knife may be required to separate part of the tibialis anticus and peronæus longus from the base of the former. The anterior part of the foot is now strongly depressed so as to stretch the dorsal ligaments, and the knife, having been thoroughly carried round the base of the fifth metatarsal, is drawn obliquely forwards and inwards so as to open the joints of the outer three metatarsals with the cuboid and the external cuneiform. The joint between the first metatarsal and the internal cuneiform is next opened, and, lastly, the second metatarsal is freed as follows: The knife being held firmly in the fist, its point is inserted between the first two metatarsal bones, and the knife carried backwards and forwards in an antero-posterior direction in the long axis of the foot (Fig. 307). The same is then done between the second and third metatarsals, and, the lateral ligaments being thus divided, the joint between the second metatarsal and the middle cuneiform is found and opened,* this being facilitated by strongly depressing the

FIG. 307.



Disarticulation of the second metatarsal in Lisfranc's amputation. The knife is being used, as described below, to separate the second from the first metatarsal bone.

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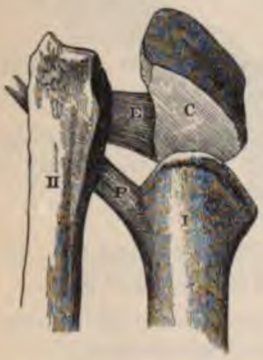
* The position of this joint must be remembered, and the way in which the base of the second metatarsal bone is locked in between its fellows and the cuneiform bones. Its base projects upwards between a third and a quarter of an inch above the others

foot, care being taken not to do this so violently as to separate the second metatarsal from its upper epiphysis, or to fracture the bone.[*] A few remaining touches of the knife, aided by a twisting movement, will then suffice to separate the foot.

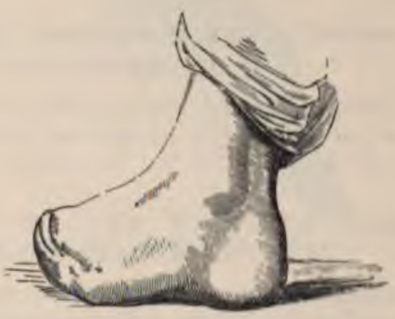
The method by disarticulation may be a useful test of a candidate's knowledge and skill at an examination. In practice, sawing through the metatarsals just below their bases may nearly always be substituted, as giving equally good results with a great saving of time and trouble. The truth of this I have personally tested.

FIG. 308.



C, Internal cuneiform. I, First metatarsal. II, Second metatarsal. E, Internal tarso-metatarsal interosseous ligament, passing between internal cuneiform and adjacent angle of second metatarsal. P, Peronæus longus. (Farabeuf.)

FIG. 309.



Stump after Lisfranc's amputation. (Fergusson.)

This method of cutting the plantar flap before any attempt is made to disarticulate is strongly recommended in preference to disarticulating immediately after making the dorsal incision by passing the knife behind the bones and cutting the flap from within outwards. In thus disarticulating before making the plantar flap, it is quite possible to puncture the tissues in the sole, and perhaps to wound the external plantar artery. Again, passing the knife behind the metatarsal bones often leads to a hitch, especially with the projecting fifth.

The dorsalis pedis and the external plantar artery are now secured with any smaller vessels which need it. Tendons are cut square, drainage provided, and the plantar flap then brought up and secured in accurate position.

Owing to the thickness of the plantar flap and its tendency at first to unfold itself downwards, numerous points of suture, of sufficiently stout wire or silk-worm gut, must be made use of.

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[*] While the surgeon is disarticulating the metatarsal bones the plantar flap must be held well out of the way to prevent its being punctured.

AMPUTATION OF THE TOES.

Practical Points.—(1) Any plantar scar is to be avoided. (2) The line of the metatarso-phalangeal joints lies a full inch farther back than the inter-digital folds of the skin (Holden). According to Erichsen, it will be found, as a general rule, that these articulations are about the same distance above the web as the points of the toes are below it. This, I think, places the line of the joints too high. (3) Partial amputations (save in the case of the great toe) are very seldom advisable, the stumps left being of little use, and inconvenient owing to their liability to stick upwards.

AMPUTATION THROUGH THE PHALANGES OR THE INTERPHALANGEAL JOINTS.

These operations are not recommended, for the reasons just given. If a patient insist on having one performed, the directions already given for the fingers (p. 2, Vol. I.) will be found sufficient.

AMPUTATION OF ANY OF THE FOUR SMALLER TOES AT THE METATARSO-PHALANGEAL JOINTS.

This amputation is performed much as in the case of the fingers (p. 6, Vol. I.), but the following points must be remembered:

(1) The line of the joint lies a full inch above the web (*vide supra*). (2) The head of the metatarsal bone is not here removed, so as to leave the supporting power of the foot undiminished. (3) It is most important to avoid, as far as possible, any scar on the sole.

The scar, a simple antero-posterior one, is well protected by the adjacent toes. The incision should always be begun on the dorsum, even in the case of the little toe, so as to avoid friction of the boots.

AMPUTATION OF GREAT TOE AT THE INTER-PHALANGEAL JOINT.

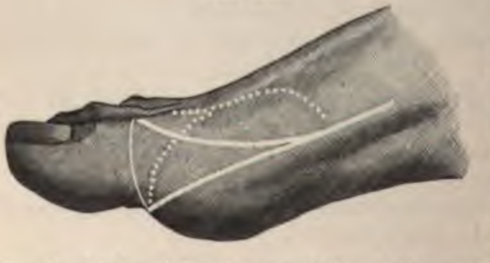
This is usually performed with a plantar flap, much as at p. 10, Vol. I.

AMPUTATION OF GREAT TOE AT THE METATARSO-PHALANGEAL JOINT (Fig. 310).

This is performed by the oval method described at p. 6, Vol. I. The following points must be borne in mind:

(1) Owing to the large size of the head of the metatarsal bone, the flaps are often cut of insufficient length. The incision must be begun an inch and a quarter above the joint, and carried well on to the phalanx, one flap being cut longer than the other if needful. (2) The sesamoid

FIG. 310.



Dorsal and internal flaps for amputation of the great toe and the head of its metatarsal. (Farabeuf.)

bones must be left in connection with the head of the metatarsal bone, as any attempt to dissect them out is likely to imperil the vascularity of the flaps, especially after middle life.

In all other details the steps of this amputation are very similar to those already given at p. 6, Vol. I.

FIG. 311.

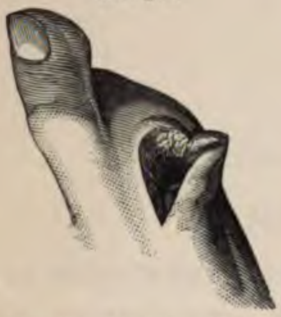
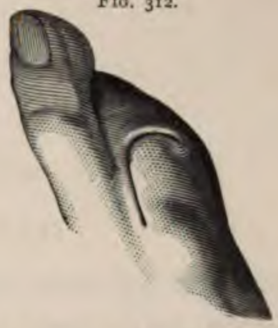


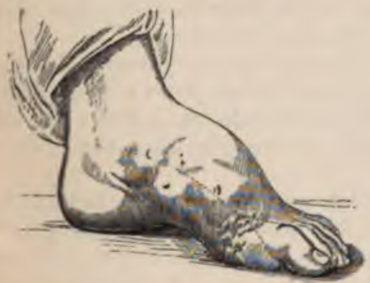
FIG. 312.



Amputation of the little toe by a single dorsal and external flap. (Farabeuf.)

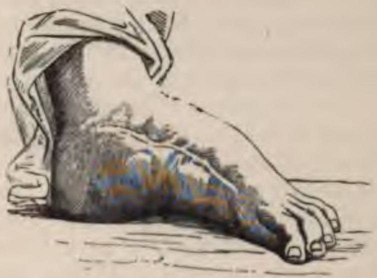
Though it is recommended by some excellent surgeons to remove the head of the metatarsal bone either transversely or obliquely from within outwards, this step, narrowing as it does the treading width of the foot, is not advisable, unless the condition of the skin is such as to render it impossible to obtain sufficient flaps to cover the entire head.

FIG. 313.



Amputation of great toe and its metatarsal bone by internal flaps. (Fergusson.)

FIG. 314.



The foot left by the operation. (Fergusson.)

AMPUTATION OF THE GREAT TOE, TOGETHER WITH REMOVAL OF ITS METATARSAL BONE. (Figs. 313 and 314.)

This may be performed by a modification of the oval method as described for the fingers at p. 9, Vol. I.

CHAPTER VIII.

OSTEOTOMY.

OSTEOTOMY OF THE FEMUR FOR ANKYLOSIS OF HIP-JOINT—FOR GENU VALGUM.—OSTEOTOMY OF THE TIBIA.

FOR ANKYLOSIS OF HIP-JOINT.

THIS includes **Adams' operation** of division of the neck of the femur and **Gant's operation** of division of the shaft of the femur just below the trochanters. The latter being much the simpler, and giving excellent results, will, I think, replace the former.

Indications.—Cases in which the hip-joint is permanently flexed and stiff, and the patient accordingly crippled, either from old hip disease, or from ankylosis after rheumatic fever, pyæmia, &c.; cases in which extension has failed, together with trials of straightening the limb with the aid of anæsthetics.

Adams' operation divides the neck of the femur subcutaneously within the capsule. It is best suited for those cases in which the neck remains unabsorbed, as in ankylosis after rheumatic fever, and, much more rarely, pyæmia. A long tenotome or a straight narrow bistoury is entered a little above the great trochanter, and carried straight down to the neck of the femur, dividing the muscles and opening the capsule freely. The knife being withdrawn, the excellent saw which bears Mr. Adams' name is passed along the wound made down to the neck of the bone, which is then sawn through. After sawing for about four or five minutes, the limb should become movable. If this is not the case, the section has been made, not through the neck itself, but through the junction of the neck and shaft.

In order to bring down the limb completely, the contracted tendons of the adductor longus, sartorius, and perhaps the rectus, will probably require division with a tenotome. The operation should be conducted with strict antiseptic precautions.

The limb is straightened at once, and put up with a long outside splint—*e.g.*, a Désault's—and a little morphia given if needful. There is no hæmorrhage, and the wound heals quickly.

This operation gives good results, though, as stated below, I pr

Gant's, owing to its greater simplicity. For there is no doubt that if the bone is dense from previous inflammation, and if the section trenches upon the shaft instead of going through the neck only, the sawing may be very tedious. Thus, I have seen two cases in which this took over half an hour.

A case is mentioned in a report from a committee of the Belgian Academy of Medicine, in which a patient who had been submitted to Adams' operation insisted on getting up on the twentieth day. Hæmorrhage came on from the fragments wounding the femoral vessels or some large branch. The femoral was tied just below Poupart's ligament; the hæmorrhage ceased, but free incisions were required for suppuration. The patient ultimately recovered. The same committee reported a death from hæmorrhage, and one from purulent infiltration. No bad results have, I believe, followed in England.

Gant's Operation.—Here the shaft of the femur is divided just below the trochanters.

Advantages.—The operation is a simpler one than that just given, as the shaft is more readily reached and divided than the neck. Furthermore, it is an operation of wider applicability, for it is suited to all cases, not only those in which a neck remains, but those more common cases of ankylosis after hip-disease, in which repair has taken place with partial displacement of the head, or what remains of it. The fact that in these cases there is next to no neck left to divide, makes them unsuited for Mr. Adams' operation.

A long tenotome or, better, a sharp-pointed, narrow, straight bistoury, is entered just below the great trochanter, and made to divide everything down to the bone as it is lodged upon the outer aspect of the anterior surface, and then drawn down over the outer surface of the shaft. As it is withdrawn, the wound is a little enlarged downwards. The saw is then introduced along the wound well down to the bone, and the outer two-thirds of this sawn through, the rest being effected by snapping the bone by lateral movements. The same tendons (p. 722) will probably require division.

In neither case is it any practical good to try and secure a false joint.

OSTEOTOMY FOR GENU VALGUM (Figs. 315–317).

Under this heading the following operations will be described :—

- I. **Division of the Shaft of the Femur from the Outer Side** (Fig. 317).
- II. **Division of the Lower End of the Femur from the Inner Side, just above the Epiphysial Line** (Macewen, Fig. 317).
- III. **Division of the Internal Condyle Obliquely** (Ogston).
- IV. **Division of the Lower End of the Femur and the Upper End of the Tibia above and below their respective Epiphyses** (Barwell).

I. **Division of the Shaft of the Femur from the Outer Side** (Figs. 315–317).—The limb being supported, with the knee flexed, on a sandbag, an incision about an inch and a half long is made at a right angle [illegible]own to the bone on its outer side, about three inches above the [illegible]ondyle. The knife—a narrow, straight bistoury—should go down to the bone deliberately, and cut firmly and strongly on it, enlarging the wound slightly as it emerges, in order that the soft parts may not be damaged if the heel of the saw is depressed, and that there may be no lip of tissues to hinder the escape of discharges. The saw or chisel is then introduced, and the bone divided for its outer two-thirds. As the thicker part of the bone is on the outer side, as soon as this is divided the inner third usually gives way readily on carrying the knee and leg from without inwards. But the operator should continue the division of the bone till he can feel certain that two-thirds are divided, for if, after dividing only half, he tries, especially in the case of a dense bone, to fracture the rest and straighten the limb, either great or prolonged force must be made use of, leading probably to irritation, cellulitis, and suppuration, with, perhaps, necrosis; or the saw or chisel must be re-introduced, a point to be always avoided if possible, as the difficulty which is usually met with in hitting off the original track will be likely to lead to the above drawbacks.

FIG. 315 *

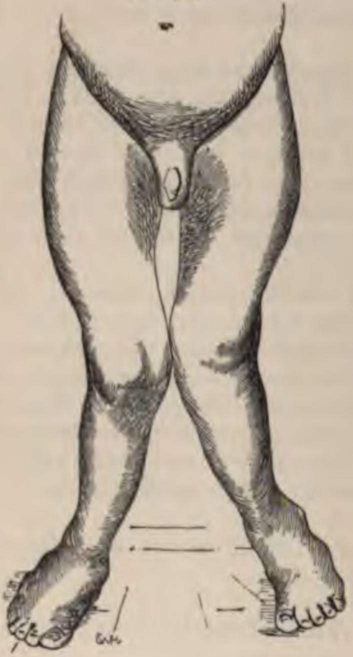
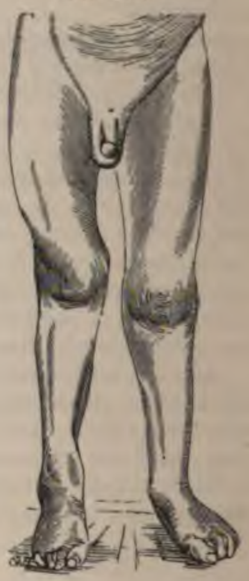


FIG. 316.*



The *advantages* of the above method are (1) that the femur is divided at a much narrower part than in the supra-condyloid operation of Macewen, and that thus it is more easily and quickly done. (2) The bone section is farther away from the epiphysis and the line of the synovial membrane, in case subsequent inflammation takes place. (3) There are no important blood-vessels near.

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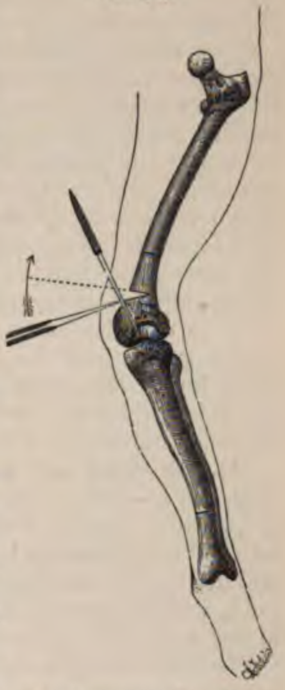
[*] Double genu valgum treated by division of the shaft of the femur from the outside. A good average case, both as to its severity and the results of operation. Some flat foot remains on the left side.

II. **Division of the Lower End of the Femur from the Inner Side, just above the Epiphysial Line** (supra-condyloid of Macewen*) (Fig. 317).—The knee being flexed and supported firmly on a sand-bag, the skin cleansed, the position of the adductor tubercle is defined, and a longitudinal incision about an inch long (a little longer than the breadth of the chisel to be used) is made down to the bone at a point where the two following lines meet —viz., one drawn transversely a finger's-breadth above the upper margin of the external condyle, and another drawn longitudinally about half an inch anterior to the adductor tubercle. The scalpel goes at once down to the bone. Superficial veins may be cut, but no artery normally distributed, as the incision is below and anterior to the anastomotica magna and above the superior internal articular. Before withdrawing the knife, the osteotome † is introduced by its side down to the bone in the same way as the knife—*i.e.*, parallel to the long axis of the limb—is then turned at a right angle to it, and the inner two-thirds cut through. *The direction of the bone-incision* is most important. The surgeon must cut transversely across the femur on a level with a line drawn half an inch above the top of the external condyle. This incision will avoid the epiphysis and synovial membrane. The line of the former may be usually represented by one crossing the femur at the level of the highest point of the femoral articulating surface, and running through or just below the adductor tubercle, so that, the incision being an inch above the tubercle, the epiphysis will be cleared. The only part of the synovial membrane which is as high as the bone incision is that under the quadriceps, which may reach in the adult as high as two inches above the trochlear surface. It is somewhat triangular in shape, its base being at the condyles, and it generally tapers to the middle line as it ascends. There is generally a quantity of fat between it and the bone. The spot selected by Dr. Macewen for his incision is posterior

FIG. 317.



The transverse line on the shaft of the femur shows the site of division of the bone from the outer side. Below this are shown Macewen's and Ogston's operations. The arrow indicates the direction in which the osteotome is worked in the former.‡ The line on the tibia shows the site of division of the bone for an ordinary rickety curve. This curve in the lower third should have been shown more marked. (After Barker.)

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* *Osteotomy*, p. 120.

† In adults a second, or even a third, finer instrument may be used, being slipped in over the first as this is withdrawn. In children one instrument will suffice.

‡ This is only safe in a child's femur; in an adult the osteotome is liable to be broken if pressed against the bone transversely to its breadth, and must only be worked in the direction of its breadth. This point, insisted upon by Macewen, has been kindly pointed out to me by Mr. Cathcart.

to this point. As in a valgous limb the whole internal condyle is lowered, a line drawn transversely from the adductor tubercle might land the operator low down in the external condyle. The osteotome must be driven at first from behind forwards and to the outer side; it is then made to move forwards along the inner border until it comes to the anterior surface, when it is directed from before backwards and towards the outer posterior angle of the femur. By keeping on these lines there is no fear of injuring the artery. The hard exterior of the bone usually resists the osteotome, especially in adults, but several strokes cause it to penetrate this superficial dense portion,* when the instrument will pass easily through the cancellous bone. The surgeon will soon recognise by touch or by hearing when the osteotome meets the hard layer on the opposite side. If it be thought desirable to penetrate this outer dense part, it must be done very steadily, so as to check any undue impetus on the part of the osteotome. A sponge, wrung out of 1 in 40 carbolic lotion, is then placed over the wound; the surgeon, grasping this and the limb with his left hand, and taking the limb again lower down with his right, gives the extended limb thus held a quick jerk inwards; this is repeated if needful, or the limb may be carried outwards, and thus broken or bent sufficiently.

III. **Division of the Internal Condyle Obliquely** (Ogston †) (Fig. 317).—This operation, though a great improvement on the operations which preceded it—viz., opening the joint and sawing off the internal condyle—has been entirely replaced by others—viz., Macewen's, and division of the shaft from the outer side. The free opening of the joint, with its great risks if the wound becomes septic, and the stiffness in any case, have led to this.

The limb, being flexed and supported on a sand-bag, a long tenotome is entered about an inch above the upper border of the articular surface of the femur exactly in the middle of the inner aspect of the thigh, and with it an incision is made down to the bone, downwards and forwards, until its point is felt beneath the skin in the inter-condyloid notch. If the patella is sufficiently dislocated outwards, the point of the saw can be felt in the groove; but if the patella is not so displaced, it must be lifted up and the point of the saw passed under it. The knife must cut down upon the bone decidedly, and, as it is withdrawn, it must enlarge the opening for the saw. An Adams' saw is then thrust along the knife track, and the inner condyle sawn off from before backwards. The bone must be sawn almost completely through, the strokes being increasingly careful as the back of the bone is reached. When the section is thought to have nearly reached this point the saw is withdrawn, the wound covered with a carbolised sponge, and the extended leg forced strongly inwards. The condyle now slips up somewhat on the cut surface of the femur.

IV. **Division of Tibia as well as Femur.**—The division of the tibia (and the fibula also) as well as the femur has been advocated by Mr.

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* The osteotomes must be bevelled on both sides, wedge-like, and sufficiently trustworthy for hardness and toughness, points only to be secured by getting them of first-rate and painstaking makers. Dr. Macewen's test is as follows: If the instrument will neither turn nor chip in penetrating the thigh-bone of an ox, it is well suited for cutting human bones.

† *Edin. Med. Journ.*, March 1877.

Barwell and others. In the majority of cases, though, at first sight, there may seem to be one striking curve localised to one spot, a closer examination shows that in reality several curves are present, and often of different kinds, antero-posterior as well as lateral, diffused over the whole shaft rather than limited to one end. In these cases, rectifying one curve often makes the others more prominent. Multiple osteotomies are required here, the femur and the tibia each requiring division in two places. In one very aggravated case of genu varum, in which the limbs (when the ankles were placed together) formed a circle, Prof. Macewen performed ten osteotomies at one time (*loc. supra cit.*, Figs. 40 and 41). In such severer cases most operators will prefer to straighten one side at a time.

Operation.—An incision is made as at p. 728 over the inner surface of the tibia just below its tubercle, and the bone divided with an osteotome or saw from within outwards. The tissue on the anterior part just below the tubercle is much the densest. The section of the tibia should be made on the same occasion as that of the femur.

However an osteotomy wound is made, whether with saw or chisel, no attempt should be made to close it, but a little iodoform dusted on and gauze dressings applied. It is very rarely needful to remove these before the tenth or fourteenth day. If a stain come through, it should be dusted with iodoform and a little fresh dry dressing applied.

Prof. Macewen uses a splint consisting of a long outside, and a short back, with a foot-piece.* I have usually preferred plaster of Paris, applied by Mr. Croft's method, for children, amongst whom my experience has mainly lain. It makes even, steady pressure upon the muscles around the wound, keeping them and it at rest, and it allows the patient to be more easily moved, especially when both limbs have been operated on. The outer piece of flannel should be brought high up, to the level of the iliac crest, so as to better command the muscles which disturb the upper fragment. Where the child is likely to be restless, a long outside splint should also be applied. I make use of this in all my cases of osteotomy of the femur. However the limb is put up, the bandages must be applied firmly and evenly, but without undue tightness. The condition of the toes, as to colour and movement, must be carefully watched. When the dressings are removed at the end of ten or fourteen days I like to have an anæsthetic given, and to rectify any slight remaining deformity.

The splints or plaster of Paris should be continued for six weeks, when the limb may be only supported with sand-bags if the union is firm. Passive and active movement may be now allowed. In about three months the patient may be got up, with a stick, under observation. Before the patient leaves the surgeon's eye, care should be taken that he can bend his knee well.

OSTEOTOMY OF THE TIBIA.

This may be (A) **Simple Division** or (B) **Cuneiform**—*i.e.*, **the taking out of a wedge of bone.** The former of these, a very simple operation, will suffice for the ordinarily curved tibiæ, where the bone is bent laterally, and the bend is most marked at the junction of the middle and lower thirds. Cuneiform osteotomy will be required when the bending is not only lateral, but antero-posterior as well.

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* Prof. Macewen advises the use of a mattress consisting of four parts, the two centre pieces corresponding to the glutæal region, and easily removed to admit of the introduction of the bed-pan.

A. **Simple Osteotomy of the Tibia** (Fig. 317).—The parts being cleansed, and the limb resting on its outer side on a firm sand-bag, the surgeon notes, at the anterior and inner margins of the tibia, the spot where the curve is sharpest. Fixing his left index over the inner margin, he enters a long tenotome or narrow bistoury exactly over the crest of the tibia, sends it down under the skin over the inner surface of the bone till its point is felt just beneath the finger; it is here pushed through the skin to make a counter-puncture for drainage. The knife, hitherto held horizontally, is now turned vertically and cuts firmly on the bone, dividing the periosteum, thick in these cases, in one line right across the inner surface of the tibia. As the knife is withdrawn it is made to enlarge the wound of entrance slightly, to make room for the saw. This (Adams') is now introduced in the same way as the knife, carried horizontally down to, but not through, the puncture through the skin of the inner border of the tibia. The left index keeping guard over the tibial artery, the saw is turned towards the bone and cuts through the inner two-thirds of it. The entrance of the saw into cancellous tissue can be known by the diminution of resistance and the increased bleeding which often occur, but the best test of the depth to which the operator has arrived is the depth of the groove in which the saw has sunk. When the bone is sawn sufficiently, carbolised lint is placed on the wound, and the surgeon, firmly placing his two hands, close together, immediately above and below the wound, sharply carries the lower fragment outwards. If the saw has been sufficiently used, the tibia snaps distinctly, while the fibula yields with a "greenstick" sensation. Great care must be taken to exert the force just on the sawn portion, or the ligaments of the ankle or the superior tibio-fibular joint may be strained and damaged. Attention has already been drawn to the need of using the saw sufficiently, otherwise the parts will be bruised and damaged in the futile attempts at fracture.

B. **Cuneiform Division of the Tibia.—Removal of a Wedge.**—The parts being duly cleansed, an incision is made along the crest of the tibia equal to the base of the wedge which is going to be removed. It need not be longer, as the skin can be pulled up and down if needful. The periosteum is then divided cleanly, and separated from the tibia with curved scissors. This membrane being held out of the way with retractors, a wedge is next removed with an osteotome or a narrow and sharp chisel but little bevelled. The gap can then be enlarged by removing from either side further shavings as required. Occasionally free hæmorrhage takes place from the medullary artery, but this soon stops with firm sponge pressure. The limb is now straightened by bending the lower fragment upwards* so as to bring the surfaces of the gap in contact. The periosteum at the upper and lower angles of the wound may be closed with chromic catgut sutures cut short. The skin wound is also closed above and below, but left open in the centre for drainage. In this and the preceding operation sufficiently thick dressings should be applied to meet any oozing from the bone. Plaster of Paris (p. 727) or back and side splints should be applied.

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* Aided by movements in the opposite direction, and from side to side if needed. The fibula is broken subcutaneously.

Cuneiform Division of the Femur.—In cases where the curve is chiefly an antero-posterior one affecting the middle of the shaft, the deformity can only be properly removed by taking out a wedge. This is done on the lines given above. An incision is made through skin and quadriceps down to the periosteum, and a second firm cut exposes the bone. The divided muscle is then drawn aside with Spencer Wells's forceps applied to bleeding points, and the periosteum separated on each side down to the linea aspera. A wedge is then removed and the bone straightened. The bleeding is often free from the nutrient artery, but this is arrested when the bone is straightened. The greatest care must be taken to keep within the periosteum, the soft parts being thus uninjured, and to adopt strict aseptic precautions.

Causes of Death and Failure after Osteotomy.

1. Septic troubles.—Such a case will be found published in the *Clin. Soc. Trans.*, vol. xii. p. 27. It is too probable that other operators have not been so candid. 2. Carboluria.—A case of rapidly fatal carbolic intoxication after antiseptic osteotomy of the tibia will be found in the same *Transactions*, vol. xiv. p. 201. 3. Hæmorrhage.—At least one case has occurred of hæmorrhage from the femoral and one from the anastomotica after division of the femur. I have also heard of a case in which the posterior tibial was injured in osteotomy of the tibia. 4. Necrosis.

This occurred in one of my cases of osteotomy of the femur, a lad of 16. It was noticed that he took the anæsthetic (ether) very badly, and when the effects of this had passed off he was extremely restless and excited for forty minutes. To this I attribute the mischief that followed. Suppuration with a very unhealthy state of the wound, œdema, and cellulitis ensued, leading to necrosis. Eventually the lad recovered, but required a cork sole of two inches. The presence of a pre-systolic murmur perhaps accounted for the effects of the anæsthetic.

5. Division of the tibialis anticus tendon.

This occurred in an osteotomy of the tibia performed by one of my dressers, who forgot how close the tendon lies to the outer side of the crest. The cut ends were joined by chromic catgut, and the action of the muscle was, afterwards, unimpaired.

CHAPTER IX.

TENOTOMY.

TENOTOMY OF THE TENDONS ABOUT THE FOOT.—SYNDESMOTOMY.—TENOTOMY OF HAMSTRING TENDONS.—TENOTOMY OF THE STERNO-MASTOID.

TENOTOMY OF TENDONS ABOUT THE FOOT.

Division of Tibial Tendons.

Tibialis Anticus.—This is usually* divided where it is crossing the ankle-joint from without inwards, a little above its insertion into the internal cuneiform. It has, here, the dorsalis pedis vessels on its outer side, but separated from it by the extensor proprius hallucis.

The surgeon usually stands on the opposite side of the leg to that of the tendon, either facing the trunk or with his back towards it, as is most convenient. The assistant stands opposite to him, grasping the foot with one hand and the leg with the other. The position of the tendon is made out by making it tense by abducting and extending the foot. The surgeon then notes the position of the anterior tibial vessels, defines exactly the width of the tendon, and places the tip of his index finger exactly on the side of the tendon farthest from him. He then inserts the tenotomy knife vertically close to the tendon on the side nearest to him; sinks it lightly till he feels sure it is on a level lower than that of the tendon; then sends it horizontally across till he feels its point just under his index finger, and, having turned its edge upwards, finally, by a series of light levering or sawing movements, cuts through the tendon. The assistant relaxes the foot—*i.e.*, adducts and bends it upwards—when the knife is first introduced, but places it on the stretch at a signal from the surgeon. Finally, as soon as the completion of the creaking sound and the sudden snap denote the division of the tendon, the foot is again relaxed. A small pad of gauze being at once applied, the foot is put up in the everted position. For this purpose nothing is, to my mind, so simple and efficient as a well-padded splint of the proper width, with two notches at its lower end, the upper end being just below the knee in infants, and the lower projecting two inches and a half below the foot. The splint is applied to the outer side, the leg being first rolled in a flannel bandage to prevent pressure-sores.

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* For tenotomy of this and the tibialis posticus I greatly prefer the site given under Syndesmotomy.

Tibialis Posticus.—It is usually recommended to divide this an inch and a half or two inches above the internal malleolus.* The tendon is here separated from the posterior tibial vessels by the flexor longus digitorum.

The surgeon and his assistant occupying positions as at p. 730, the exact site of the tendon is defined, if possible, by abducting and bending down the foot. In fat infants it is often quite impossible to feel the tendon, and in these cases a spot midway between the anterior and internal borders of the leg will be the best guide, as denoting the inner margin of the tibia. The surgeon then introduces a sharp tenotome so as just to touch, if possible, the inner margin of the tibia, taking care to sink the blade sufficiently to open the sheath freely. This being done, a blunt tenotome is introduced through the same opening, and pushed under the tendon; the edge being then turned towards it, and the tibia used as a fulcrum, the tendon is severed, together with that of the flexor longus digitorum. The assistant first relaxes and then extends the tendon, as advised above (p. 730).

If the artery be cut, as shown by the jetting hæmorrhage and the blanching of the foot, firm pressure must be applied, the foot being first bandaged. No eversion must be practised, but the foot put up in the faulty position for about a week.

Plantar Fascia.†—This may be divided just below its origin from the os calcis, or in advanced cases close to the transverse crease, which is here found in the sole. With regard to this fascia, the surgeon should not tie himself down to any fixed spot, but divide resisting bands whenever they are felt.

Syndesmotomy.—This term has been introduced by Mr. R. W. Parker (*Congenital Club-foot*, p. 62 *et passim*), who believes that in many cases—*e.g.*, severe ones, cases not treated in early life, and in some relapsed cases—the foot cannot be rectified even by multiple tenotomy. He attributes this, not to adhesions, but to the faulty shortness, and unyielding nature of the ligaments. Chief amongst these, in equinovarus, are the ligaments about the astragalo-scaphoid joint. "In these cases there is a capsule made up above and internally by a blending together of the superior astragalo-scaphoid ligament with fibres from the anterior ligament, and the anterior portion of the deltoid ligament below with fibres from the inferior calcaneo-scaphoid ligament. To these are united fibrous expansions of the tendons of the anterior and posterior tibial muscles; together they form an unyielding capsule of great strength, which is attached to the several bones, not in the usual manner, but in adaptation to their altered relative positions. This I would name the 'astragalo-scaphoid capsule.'" Mr. Parker gives directions for dividing this structure which can be made to combine division of the tibial tendons in a manner which I consider far more satisfactory than that already given. Since reading his book I have adopted his method in eighteen cases with good results. I much prefer it to that usually followed.

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* The tendon is here rather farther from the artery, and the surgeon will be above the commencement of its synovial sheath, in which it traverses the internal annular ligament.

† Division of the palmar fascia is fully described at p. 22, Vol. I.

The site chosen for this combined division of tendons and ligaments is a little below and anterior to the tip of the internal malleolus.* Other guides are the site of the astragalo-scaphoid joint, and in older cases the transverse crease which, running down on to the sole, denotes the inversion of the foot. Two tenotomes are required, one of ordinary pattern, and one curved, somewhat sickle-shaped, and with a cutting blade about half an inch in length.

The surgeon notes the position of the arteries, and the lines along which the tibial tendons are curving towards the internal cuneiform. Having marked, at the spot above given, the position of these tendons, he enters a sharp-pointed tenotome, the parts being relaxed, just above the posterior tibial artery, and pushes it outwards on to the dorsum to a spot just short of the dorsalis pedis artery, the knife travelling just beneath the skin to make a path for the next instrument, which does the work. The curved tenotome is then inserted under the skin, and pushed on, flat-wise, till its tip can be felt over the tibialis anticus; it is then turned blade downwards, the tibialis anticus is felt to give way, and, as the knife cuts on the subjacent bones and cartilages, the ligaments are felt to yield to it, while, as it is withdrawn, its edge divides the tibialis posticus.

The internal saphena vein would seem to lie under this incision, but the hæmorrhage, never marked, is usually very slight. As I have stated, the results in the eighteen cases in which I have used this method have been excellent, though in two I was unable to satisfy myself that the tibialis posticus had given way; in one it was certainly notched, and yielded subsequently.

As here the incision is made from the skin down upon the tarsal bones, I have used irrigation with lotion of mercury perchloride or carbolic acid. The wound is a comparatively free one, but quite subcutaneous, starting from a mere puncture.

As I have stated, I prefer to put up a case of talipes varus after syndesmotomy, with the foot everted at once, on a notched splint like a Dupuytren's, but applied to the outer side. If the tendo-Achillis requires division, this is done in a few days, and the foot put up for about a week, in good position, by Mr. Croft's method of plaster of Paris. After this, in early life, the foot must be manipulated *daily* by the surgeon for a while, and several times daily by the friends, the surgeon seeing it at first every other day. If these manipulations are persevered with daily by the mother or nurse, and the case kept under the surgeon's eye, expensive boots and other apparatus will not be needed in children.

Tendo-Achillis.—This should be divided half an inch above its insertion in an infant, and an inch and a half in an adult.

The foot and leg being turned well over on to the outer side, and the tendon being relaxed by the assistant bending the foot downwards, the margins of the tendon are accurately defined. The knife is then introduced vertically close* to the inner side of the tendon till it reaches a sufficient depth to ensure being beneath it;† it is then pushed horizontally across under the tendon till it is felt under the skin by the left index finger, which accurately marks out the outer limit of the tendon; the blade is then turned towards the tendon, which being at the same time put on the stretch by bending up the foot, is divided by a series of levering movements of the handle. Creaking movements, followed by a sudden snap or thud, denote complete division, when the tendon is to be at once relaxed and the knife brought out horizontally.

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* Mr. Parker (*loc. supra cit.*, p. 78) shows that Velpeau and Syme pointed out the possibility of dividing the tendon of the tibialis posticus here.

The Peronæi.—The peronæus longus and brevis occasionally require division. They may be divided simultaneously by entering a tenotome between them and the bone about two inches above the external malleolus. Immediately above this process they are more under cover of the bone. If divided below it, their synovial sheath would be opened; this is to be avoided in case of sepsis.

TENOTOMY OF THE HAMSTRINGS.

The patient being rolled two-thirds on to his face, the surgeon stands on the same side as that on which lies the tendon to be divided, facing or turned from the trunk as is most convenient. An assistant stands opposite to him to relax and tighten the tendon.

Biceps.—The exact limits of the tendon being defined, the surgeon introduces a sharp knife close to the inner side of the biceps, so as to get between it and the external popliteal nerve, and having sunk it sufficiently to get beneath the tendon, pushes the knife outwards, horizontally, till it is felt beneath the skin under the left index, which marks the outer limit of the tendon. The edge being turned towards this, the tendon is extended by the assistant, and divided in the usual way. When this is done, the limb is flexed and the knife withdrawn horizontally.

When the tendon is cut, a cord often rises up close to it. This is the nerve, and the knife must on no account be re-introduced.

If, after tenotomy in long-standing cases, any contracted bands of fascia do not give way to extension, which they will generally do, it is wiser to make a small open wound, antiseptically, and divide them thus, that the surgeon may be certain as to what he is dividing. The wound is united afterwards with one or two horsehair sutures.

Semi-tendinosus and Semi-membranosus.—These tendons can be divided in the same way as the biceps. A contracted knee can generally be straightened after division of the biceps and semi-tendinosus. If it is needful to insert the knife more deeply so as to divide the semi-membranosus, it would be well to use a blunt-pointed tenotome, or to operate through an open incision.

In one case of a girl of 16, after I had divided the biceps and semi-tendinosus, I had dipped the point of the knife a little more to ensure division of the deeper and

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* So as to avoid the posterior tibial artery.

† Young operators often do not insert the knife sufficiently deep; they thus, when it is pushed across, get into the tendon instead of beneath it, and so divide it incompletely.

larger semi-membranosus. Most profuse hæmorrhage followed from the superior internal articular vessels. Firm padding and bandaging were applied, and the limb put up in the faulty position for four days. No recurrence of the bleeding took place.

TENOTOMY OF THE STERNO-MASTOID.

The two heads are best divided from separate **punctures** just above the clavicle. The muscle being made prominent, by one assistant manipulating the head and another depressing the shoulder, the surgeon, standing facing the patient on the side to be operated upon, defines the limits of the inner border of the sternal tendon, opens the fasciæ sufficiently freely here, and then, taking a blunt-pointed tenotome, insinuates it horizontally behind and close to the tendon till it is felt just beneath his left index finger, which is placed at the outer margin; the edge is then turned towards the tendon, and divides it. It is withdrawn with the usual precautions. The clavicular tendon is divided in a similar way through another puncture.

Care must be taken to avoid the anterior jugular, which runs outwards under the muscle a little above the clavicle, and the external jugular, which lies at a varying level close to the outer border of the clavicular head. If a sharp tenotome were dipped too deeply, the internal jugular might also be wounded.

If any smart venous hæmorrhage occur, a pad of dry gauze should be firmly bandaged on.

The **open method,** in which the muscle is divided on a director after a skin incision has been made transversely over its lower third, and its borders defined, is advised by some as allowing of every step being seen, avoiding abnormal vessels, and securing, not only complete division of the muscle, but also of any fascial bands. These I have very rarely met with. The scar is said to be slight if the wound is sutured and carefully dressed (Tubby, *Orthopædic Surgery*, p. 202).

Causes of Failure after Tenotomy.

1. Septic troubles. These usually arise from the use of dirty instruments which clean themselves at the patient's expense, or from making an open wound. 2. Incomplete division of the tendon. 3. Division of important structures—*e.g.*, the tibial arteries, the external popliteal nerve, the anterior or internal jugular veins. 4. Non-union of the tendon. 5. Mal-union of the tendon—*i.e.*, adhesions formed by it to adjacent structures, *e.g.*, its sheath or a bone. These must both be extremely rare. 6. Breaking off the point of the tenotome, usually against a bone.

CHAPTER X.

OPERATIONS ON NERVES.

NERVE SUTURE.—NERVE STRETCHING.

NERVE SUTURE.

THIS may be required as a **primary** or **secondary operation**. The latter is accompanied with much more difficulty, owing to the greater retraction of the nerve ends, their bulbous or filiform extremities, their being often buried in scar tissue or matted by it to neighbouring parts —*e.g.*, tendons and fasciæ ; to which must be added other unfavourable points—*e.g.*, the atrophy and fatty change in the muscles and the stiffness of the joints.

Primary Suture.*—As the mode of uniting nerves will be fully described under the head of secondary nerve suture, the more difficult proceeding, it need not be repeated here. It only remains to emphasise the importance of always resorting to it, and not trusting to spontaneous cure. Howell and Huber (*Journ. of Physiol.*, vol. xiii.) have collected eighty-four cases of primary nerve suture; 42 per cent. of these were successful, 40 per cent. were improved, and in the remaining 18 per cent. the operation failed. The results of secondary suture can never be so good as these.

Secondary Suture.—The operation on the median or ulnar will be considered, as these are so commonly injured. The following steps must be remembered : (1) Finding the nerve ends. (2) Freeing and refreshing them. (3) Passing the sutures, and bringing the ends into apposition. (4) Dressing the wound, and the after-treatment.

1. *Finding the Nerve Ends.*—With accurate anatomical knowledge this is easy. An Esmarch's bandage does not appear to be necessary, as the incision is made parallel with the vessels, and the use of one leads to oozing afterwards. Mr. Bowlby (*loc. supra cit.*, and Hunt. Lect., *Lancet*, July 16, 1887) thinks that the parts should be rendered bloodless. If this course is adopted care must be taken to provide

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* Much information on the subject of primary and secondary suture will be found in the section on Suture of Tendons (p. 30, Vol. I.).

sufficient drainage, and the upper bandage must, if possible, be applied sufficiently far from the wound not to interfere with pressing down the parts when the nerve ends are approximated. If bandages are employed, the parts should be made absolutely evascular; careless application will only cause most annoying oozing. An incision, two to three inches long, being made over and parallel to the nerve ends, the deep fascia and any scar tissue are carefully divided and the ends found, the upper bulbous and the lower filamentous usually, and not always in a line with each other. If the distal end be very difficult to find owing to its filiform shape and its being embedded in scar tissue, the wound should be prolonged, the nerve found lower down, and traced up to the distal end. The ends are next freed from the adjacent parts, and cleared of cicatricial tissue.

2. *Resection of the Nerve Ends.*—This is best effected by *sharp* scissors, with one stroke, and without any bruising. If the nerve is held with forceps, these must hold the sheath only. In case of primary suture, jagged or frayed ends need only be pared sufficiently. In later cases there is much more difficulty. Supposing the upper bulbous end to be taken first, I think that before this is pared the nerve should be carefully stretched,* so that dissecting-forceps or any other means of holding the nerve may inflict any necessary damage on parts that will be cut away. It is not necessary to cut away the whole of a bulb; removing the greater part will expose healthy nerve fibres. Mr. Bowlby (*Inj. and Dis. of Nerves*, p. 165) advises that the section of the upper end should be carried through the uppermost part of the bulb, close to the normal trunk. Not only will numerous young fibres be found here, but, as he points out, the tougher tissue of the bulb affords an excellent hold for the sutures. With regard to the lower end, Mr. Bowlby thinks that all that is needed is "to cut away the extreme end, which, being matted with fibrous tissue and compressed by the surrounding scar, is very likely to contain no nerve tubules. It is seldom necessary to remove as much as a quarter of an inch, and, however unhealthy the section may look, no good is ever to be gained by a further sacrifice."†

3. *Passing the Sutures and bringing the Nerve Ends in Apposition.*—The suture should be of properly prepared carbolised silk or chromic gut. There has been much dispute as to whether they should be passed through the substance of the nerve itself or only through the sheath. Experience has shown that the former practice is not only harmless to the nerve, but is the method most generally applicable. In a few cases, as in that of a large nerve, where there is but little separation, and where the damage is just inflicted, it may be sufficient to pass the sutures through the sheath only. But in the opposite class of case the sutures should be passed through the nerve itself, and at a sufficient distance from the ends—viz., at least a quarter of an inch—otherwise, they will cut out when they are tightened. Where there is much

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* An Esmarch's bandage, if applied, will be found in the way now, interfering, as it usually must, with the stretching of the nerve.

† As the whole length of the lower end is in the same condition of degeneration throughout, manifestly no good can be done by cutting off successive sections in the hope that the cut surface may look more healthy than that which is seen in the first section (Bowlby).

separation, several sutures should be passed through part of the depth of the nerve, one suture thus taking off some of the tension from its fellows. Another method is to pass one suture completely through the nerve trunk at least a quarter of an inch from each cut end. When the sutures in the nerve itself have been tied, two or three more very fine ones may be placed in the sheath, where the nerve is large enough.*

In cases of much separation, before any sutures are passed, and again before they are tied, the parts should be as much relaxed as possible, and the upper end brought down by pressing down the soft parts. Stretching the nerve has been already advised (p. 736).†

All hæmorrhage being scrupulously arrested, and drainage provided by horsehair or a fine tube according to the amount of the disturbance of the parts, &c., the usual dressings are applied, and the limb placed on a well-padded splint in a position which will best retain the nerve ends in apposition with the least discomfort to the patient.

Amount of Nerve Tissue which may be Successfully Removed.—From half an inch to three-quarters of an inch is probably an average amount.

Causes of Failure.—1. Wide separation of ends. 2. Atrophy, bulbous enlargement and sclerosis of nerve ends, so marked as to require much trimming, and thus tending to wide separation. 3. Unnecessarily rough handling of the nerve ends. 4. Suppuration of the wound.

Aids in Difficult Cases.—1. Previous stretching of the ends. 2. Approximation of the ends by position of the limb. 3. Using several sutures, which distribute the tension evenly. 4. The use of "stitches of fixation" (p. 32, Vol. I.). 5. Autoplastic operation with nerve-flaps. M. Letiévant advises to make a slit through the nerve with a narrow bistoury about one-fifth of an inch from the end; the knife being then carried upwards for an inch or an inch and a half, is made to cut to one side so as to make a flap. The same is then done with the lower end, and the two flaps, being turned towards each other, are united by their raw surfaces (Fig. 29, Vol. I.). 6. Gluck and Vanlair advise that the nerve ends, whether united or only placed as closely as possible in apposition, should be passed through and left in a decalcified bone-tube, so as to keep the uniting material and granulations in a straight line. 7. "Distance sutures," *i.e.*, the substitution of threads of silk and catgut may be tried (p. 32, Vol. I.). 8. Cheyne and Burghard (*Man. of Surgical Treatment*) recommend a combination of the last two plans, but do not mention any results. 9. Scar tissue may be used as a bridge between the ends. Thus, Mr. Pick (*Lancet*, 1892, vol. i. p. 693) in a case of secondary suture of the median nerve more than two years after the injury, found lying beside the upper cut end some organising inflammatory material. Dissecting this from the side of the nerve, and leaving it still attached to the lower end of the upper piece, he turned it down, and sutured it to the lower end of the nerve. When the patient was last seen the function of the nerve was in process of restoration. 10. Implanting one nerve trunk upon another. Thus, where the ulnar is too widely destroyed to bring the ends together, the distal end frayed out, has been stitched to the median, the sheath and superficial fibres of this having been first removed. The success seems to have been slight and partial. Dr. R. Harvey Reed, of Columbus, Ohio, publishes a case successfully treated after the following method, which he credits to Dr. W. I. Galbraith, of Omaha, Nebraska. This is intended to meet those cases where the gap between the central and peripheral ends is so great that it cannot be met by suture, or bridging across by catgut, or tunnelled over by a tube of decalcified bone. Dr. Galbraith has shown by a case that, under the above circumstances, if the injured nerve have another parallel with it, the central end of the injured one can be implanted into a parallel nerve at a certain point, and that two or three inches lower down the peripheral end can be implanted into the same nerve. 11. Perhaps the use of zigzag incisions made in the upper end (Fig. 25, Vol. I.). 12. Making use of nerve-grafts. Gluck has resected an inch and half of the great sciatic in chickens, and replaced it by a bit of a rabbit's sciatic sutured in. The birds walked afterwards as well as those treated by direct suture.

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* To prevent the adhesion of the recently united ends to neighbouring parts, short strands of catgut may be placed beneath them, but this is not essential.

† In cases where, in spite of all precautions, much tension is evidently left on the sutures, it might be well to make use of "stitches of fixation," as in tendon suture (p. 32, Vol. I.).

The following is, I believe, the first case of nerve-grafting in this country. Mr. Mayo Robson (*Clin. Soc. Trans.*, vol. xxii. p. 120) after the removal of a growth from the median nerve, leaving a gap of two inches and a half between the ends, successfully made use of a corresponding bit of the posterior tibial nerve from a limb which was amputated in the adjoining theatre.* The following conditions are rightly given as essential: First, the entire absence of tension; two inches and a half of nerve being employed to fill an interval of two inches and a quarter. Secondly, great care was observed in handling the nerve to be transplanted. Thirdly, the transplanted posterior tibial nerve was transferred immediately as living tissue into its new bed. Fourthly, only one fine catgut suture was employed at each end to fix the nerve. The same surgeon successfully used the spinal cord of a rabbit as a graft in the median nerve of a man (*Brit. Med. Journ.*, Oct. 31, 1896, p. 1312).

In a very instructive paper by Mr. Damer Harrison, of Liverpool (*Clin. Soc. Trans.*, vol. xxv. p. 166), some nine other cases of nerve-grafting are given. The nerves used were the sciatic of recently killed rabbits or kittens, and the median from a human arm. Of the ten cases, three are stated to have been perfectly successful, six partially successful, and only one a failure.

Mr. Heath made use of nerve-grafting, replacing the gap in the ulnar by a portion of posterior tibial nerve (*Lancet*, 1893, vol. i. p. 1195). A fibro-sarcoma had been removed from the ulnar nerve on the inner side of the right arm, but it had been found impossible to bring the ends of the nerve together, as a gap of two inches existed between them. Four days after the first operation the wound, which was healing well, was reopened, and enlarged at either end. The ends of the ulnar were found, and about one-eighth of an inch cut off from each end. Then two and a half inches of the posterior tibial nerve from a limb which had just been amputated by Mr. Beck for sarcoma of the lower end of the femur were grafted into the gap in the ulnar nerve. The graft was retained in position by two fine silk sutures at either end. About twenty minutes elapsed from the time at which the limb from which the nerve was taken was severed from the body and the time when the junction of the piece of nerve with the ulnar nerve was completed. The wound healed by first intention, but fourteen months later there was no restoration of function in the nerve.

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* In its brief transit the nerve was placed in a solution of carbolic acid (1 in 40).

Mr. M. Moullin, in a case of old injury to the musculo-spiral nerve, grafted in about two inches of the great sciatic of a rabbit, but without success.

The graft does not remain as nerve tissue, but merely acts as a conducting material for the growth of the new nerve fibrils, in the same way as strands of catgut may do.

13. In cases of injury to the musculo-spiral nerve, where the ends are too far apart to admit of their junction by suture, they have been successfully approxmiated by resecting sufficient of the humerus—Wheeler (*Lancet*, 1894, vol. i. p. 939), Mann (*ibid.*, 1893, vol. ii. p. 59).

Period Required for Repair.—The following appears to be a fact not sufficiently recognised. The period required for union after secondary nerve suture is very much longer than is usually supposed to be necessary, owing to the peripheral end being degenerated, the muscles atrophied, and the joints fixed. Complete restoration of function will often require from one to two years. A patient who leaves his surgeon apparently but little better for the operation may return at the end of the above time with his limb practically restored to its natural condition. Mr. Bowlby (*loc. supra cit.*) writes: "If there is one fact more than another which stands out in the clinical histories of patients who have been under my own observation, it is that after the failure of union by first intention, after trophic changes of many kinds, after complete atrophy and degeneration of the paralysed muscles, recovery may yet be complete."

It is the condition of the muscles and joints which alone puts anything like a limit on the period at which secondary suture can be successfully practised.

The longer the interval* between the injury and the suture, the more perseveringly must friction, electricity, passive and active movement, and massage be made use of, and the more will patience be required by both patient and surgeon.

NERVE STRETCHING.

This operation, introduced into England in 1880, and much used in the immediately succeeding years, has fallen into abeyance, the clinical results having failed to come up to the expectations raised by the operation.

Indications.—Of the following list it is only in the first six that the operation can be considered justifiable.

1. Neuralgiæ.—In all cases where previous treatment has failed, nerve stretching may be practised before division of, or removal of, part of a nerve. The conditions justifying this in facial neuralgia have been already given (p. 317, Vol. I.). As, however, the results of neurectomy for

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* The longest of these with which I am acquainted is a case of M. Tillaux's in which fourteen years had elapsed between the injury to the median and its suture.

facial neuralgia are far superior to those of nerve stretching, the latter is only to be recommended on the ground that, owing to the inveteracy of the disease, recurrence is only too probable even after neurectomy, and thus a previous nerve stretching may give a further period of relief. 2. Sciatica.—Nerve stretching is especially indicated here in cases due to rheumatic inflammation of the nerve from exposure to cold and wet. Dr. J. P. Bramwell has published (*Brit. Med. Journ.*, June 19, 1880) five cases of this kind, in which much benefit followed stretching the great sciatic. The more definite is the sensation of adhesions broken down at the time of the operation, the better is the prognosis. 3. Locomotor ataxy.—One or both great sciatics have been stretched with a view of improving the lightning pains, the involuntary jerkings of the lower limbs, and the gait.* While improvement for a varying period may always be expected as far as the first two are concerned, the prospect of improving the ataxy is very doubtful. Furthermore, the slow healing of the wound in these cases must be borne in mind. 4. Spasmodic contractions of voluntary muscles.—Here the operation seems to have been followed by success, temporary at least, in a very large number of cases. Where the spasmodic affection is of traumatic origin—*e.g.*, where a limb, after a contusion, is at the same time contracted and the seat of spasmodic movements—stretching of the nerves concerned may be absolutely curative. Quite another class of case—viz., stretching the facial for tic convulsif—has been considered at p. 329, Vol. I. 5. Reflex epilepsy.—Prof. Horsley (*Dict. of Surg.*, vol. ii. p. 61) states that, in those cases of epilepsy where the attack is preceded by violent pains localised distinctly to different nerves, very marked relief (amounting to cure in several instances) has been obtained by stretching the nerve trunks thus indicated. 6. Anæsthesia of leprosy.—Lawrie, of Lahore, seems to have met with striking success, the fifty cases published being all successful. The late Dr. B. Rake (*Brit. Med. Journ.*, 1890, vol. ii. p. 953) advised repeated stretching of the great sciatic as preferable to amputation for the painful perforating ulcer of leprosy. 7. Infantile paralysis.—Prof. Horsley (*loc. supra cit.*) states that in 1861 Dr. Bastian had the great sciatic nerve stretched to improve the nutrition in a limb the seat of the above disease. The effect was to markedly increase the temperature and colour of the part, and apparently improve the state of the tissues. The result, however, does not seem to have been such as to find imitators.

Operation.—The following remarks refer to the great sciatic only, the nerve which has been most frequently stretched.

The parts being cleansed, an incision about four inches long is made over the nerve in the centre of the back of the thigh, commencing about an inch and a half below the lower border of the glutæus maximus. The interval between the hamstrings being hit off, retractors are inserted, and the nerve found a little to the inner side of the biceps. The fatty tissue around it is then carefully incised till the white epineurium itself of the nerve is exposed. The nerve, being most entirely separated from adjacent parts, is now stretched. The force with which this is accomplished must vary somewhat with different cases. Thus, in sciatica, the index finger[*] being hooked under the nerve, this should be raised well out of its bed in the hope of adhesions being felt to give way both at the part stretched and at a distance also.

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* In a case of Dr. Bastian's (*Brit. Med. Journ.*, July 2, 1881), the patient, in an advanced stage of ataxy, experienced so much relief from the stretching of one great sciatic, that he asked for an operation on the other side. An interesting paper by Dr. Cavafy, with nineteen cases collected from different sources, will be found in the *Brit. Med. Journ.*, 1881, pp. 928, 973.

In the case of locomotor ataxy the same amount of stretching—viz., hooking up the nerve some two inches above the level of the skin, and some four or five above its bed, this being repeated twice in a centrifugal and centripetal direction—has been followed by satisfactory results. In other cases the pull has been more forcible, care being taken to lift the limb off the table several times. In any case the pull must be without jerks, steady and continuous, and kept up for some three minutes. Mr. Marshall (*loc. supra cit.*) thought that a force equal to thirty or forty pounds should be the limit for the sciatic. He thus gave an idea of the above force: "If I first pull as hard as I imagine I should do upon a living sciatic nerve during an operation, I find that the force employed is about equal to twenty pounds; but if I pull very hard, it is increased to thirty pounds, and that, I believe, is as hard as a surgeon could well pull when holding a soft nerve between his finger and thumb." The direction of the pull, whether downwards from the trunk or upwards from the limb, has been a good deal disputed. Mr. Marshall (*Bradshawe Lecture*, p. 28) thought that in neuralgia the stretching should be performed both ways. In ataxy it is essential to stretch down from the body.

The nerve, being found to be loose and elongated, is replaced in its bed, any bleeding points are attended to, drainage provided, and the wound carefully closed. Antiseptic precautions must be made use of throughout, and the limb kept quiet with a splint or sand-bags. The tardy healing of the wound in cases of ataxy has been already alluded to.

In cases of stretching for sciatica, gentle movements of the limb should be begun as soon as possible to prevent the re-formation of adhesions.

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[*] In the case of smaller nerves a blunt hook would be employed.

PART VI.

OPERATIONS ON THE VERTEBRAL COLUMN.

SPINA BIFIDA. — LAMINECTOMY. — RACHIOTOMY. — PARTIAL RESECTION OF THE VERTEBRÆ.—TAPPING THE SPINAL THECA.

SPINA BIFIDA.

Indications.—All operative treatment should, if possible, be postponed until the child is two years of age or older. The operation is then borne far better, as is shown by published results. Where, in younger children, rapid increase in the size of the tumour is, however, taking place, and leakage is threatening or has actually occurred, the methods of injection or tapping may be resorted to as palliative measures, although the results, with few exceptions, will be disappointing. Briefly, the smaller the tumour; the less the evidence of involvement of the spinal cords or nerves;* the more the skin over the tumour approaches to normal; the less the tumour shows signs of increase in size; and the older the child—the greater are the chances of cure. The greatest possible importance, therefore, attaches to the question of careful selection of cases to be submitted to operative interference.

Operations.—1. **Injection with Morton's Fluid.** 2. **Simple Tapping and Drainage.** 3. **Excision.**

All the above are liable to be followed by septic meningitis aided by the constant soaking away of cerebro-spinal fluid, especially where the coverings of the sac are thin and unhealthy.

1. **Injection with Morton's Fluid.**—The Clinical Society's Committee (*Trans.*, vol. xviii.) collected 71 cases treated by this method. Of these, 35 recovered, 27 died, 4 were relieved, and 5 unrelieved. In a letter to the Committee (dated May 11, 1885), Dr. Morton was able to refer to 50 cases thus treated. Of these, 41 appear to have been suc-

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* Points which make it probable that nerve trunks or the cord, or both, are present in the sac, are paralysis of the sphincters or lower extremities, a large sessile tumour with a broad base, and the appearance of cord-like bands when the sac is thin enough to transmit light.

cessful, and 9 unsuccessful. But it is obvious that these statistics are largely unreliable. It is not unfair to say that nearly every successful case has been at once reported, while scores of unsuccessful ones have never been heard of. Owing to the large number of successes which attended the use of this method, it is the only one which was recommended by the Committee of the Clinical Society. It is impossible to point out too strongly to my younger readers that it is only by a judicious selection of cases that any success can be expected.

The sac being cleansed, a syringe which will hold about two drachms of the iodo-glycerine solution* is chosen, and a fine trocar. The calibre of this must not be too fine for the thick fluid which has to pass through it. The puncture into the swelling should be made well at one side, obliquely through healthy skin, and not through the membranous sac-wall, the objects being to avoid wounding the cord or nerves, and also to diminish the risk of leakage of cerebro-spinal fluid. Unless the sac is very large it is probably better not to draw off much, if any, of the fluid from the sac on the first occasion. The position of the child during the injection has been a good deal dwelt upon, most recommending that it should be upon its back. The Clinical Society's Committee advise that the child should be upon its side. About a drachm of the fluid should be injected. Every care must be taken to prevent any continued escape of the cerebro-spinal fluid, now and later, it being clearly understood that any such leakage, which is most difficult to prevent, will lead to septic meningitis and death. When the needle is withdrawn the puncture should be pressed around it, and immediately painted with collodion and iodoform, a dressing of dry gauze being also secured with collodion. I prefer to give a little chloroform to prevent any crying and straining at the time. The child should be kept as quiet as possible afterwards, on its side, and an assistant should make sure, for the first hour at least, that no leaking is going on. Shrinking of the cyst, continuing steadily, shows that all is well. If the injection fail altogether, or only cause partial obliteration of the sac, it should be repeated at intervals of a week or ten days.

2. **Simple Tapping and Drainage.**—This consists of either tapping with a very fine trocar and carefully sealing the opening, or inserting a single piece of horsehair as a drain. The use of the horsehair drain is not to be recommended, as the leakage cannot be kept sweet. The method is only palliative.

3. **Excision of the Sac.**†—This is the method which I recommend, and which, in spite of certain grave dangers, promotes, I think, the best results in carefully selected cases. The dangers are, of course, the suddenness with which the fluid may escape, with grave resulting changes in the hydrostatic pressure and circulation in the cerebro-spinal system, shock from interference with important nerve filaments, and meningitis set up as the result of subsequent leakage.

The too rapid escape of fluid can be prevented in great measure by preliminary tapping and attention to the position of the patient. The presence of nerves in the sac is a graver matter, but with a larger experience surgeons will, I believe, find that the nerves and the closely contiguous sac can be safely returned within the canal, and, when replaced, covered over. On this point Mr. M. Robson (*Ann. of Surg.* 1895, vol. ii.) writes: "Even when nerve cords are involved in the sac, an aseptic plastic operation can not only be safely performed, but will actually do less damage to these important structures than the injection of an irritant, which, if it does not lead to rapid death by shock or convulsions, or to a general irritation of the nerve centres rapidly tending to hydrocephalus, is followed by a shrinking and atrophy of the sac and its contents, whether nerves or spinal cords."

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* The fluid is iodine, gr. x; iodide of potassium, ʒj; glycerine, ℥j.

† The Clinical Society's Committee collected 23 cases treated by excision of the sac. Of these, 16 recovered, 7 died. They point out that no mention of the contents of the sac is made in 6 cases; that nerves were certainly absent in 16 cases; and that i[illegible] was fatal, they were certainly present (*Trans.*, vol. xviii. p. 380).

Operation.—The parts having been cleansed and arrangements made for keeping the head low prior to and during the opening of the sac, elliptical incisions* are made through the skin on either side on and sufficiently far from the base to ensure if possible (*a*) sound skin and (β) sufficient skin to meet in the middle line after partial excision of the sac and removal of the fluid. The skin is then dissected back on each side with great care so as to avoid, if possible, punctures of the membranes, until the laminæ are reached. It may now be found that the tumour is clearly a meningocæle being attached by a pedicle, which may be quite slender. In such a case the tumour may be forthwith removed after ligature of the pedicle. This was done with success in two cases in adult women by Mr. Clutton (*Ann. of Surg.* vol. i., 1898, p. 253). In both cases the tumour was situated in the sacral region.

If there is no pedicle the sac is now carefully opened, at first with a trocar so that the fluid is slowly withdrawn, and the effects on the cerebral centres noted. The opening is then enlarged, and the interior carefully examined. If no nerve structures are present, the redundant sac is then cut away with blunt-pointed scissors, and the edges brought together with a continuous suture of catgut or, better, kangaroo tendon. So far the operation has been simple and straightforward. We must now consider more difficult cases. Where the coverings are in great part thin and translucent, even when this condition extends to the margin of the swelling, if the coverings can be rendered aseptic they may be partly utilised to form the meningeal flaps, the adjoining skin being undermined and made to slide over the new meninges (Mayo Robson).

When on opening the sac nerve structures are seen within, that part of their course which lies in the sac must be carefully detached with blunt-pointed instruments, until they can be gently pushed through the opening that communicates with the spinal canal. In more difficult cases, incisions must be made with blunt-pointed scissors between portions of nervous structures, in order to set them free, or they must be returned with a part of the sac *en masse*. In cases where the presence of nerve structures difficult to detach is marked, the safest plan will be the last. Having opened and examined the sac, the surgeon cuts away any superfluous part that is safe, then detaches the remainder and returns it with the nerves which run in it, through the opening, into the canal.* It is greatly to be desired that surgeons should specify what nervous structures were present, and how they were dealt with. As a rule this has been most imperfectly done.

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* A precaution of Mr. Robson's (*Clin. Soc. Trans.*, vol. xviii. p. 211) should be followed here. The skin and meningeal flaps should be so cut that their lines of union, when sutures are applied, are not opposite. Thus, the flaps should be cut of unequal width, so as to bring, *e.g.*, the wider skin flap on the left side, and the wider meningeal one on the right.

The nerve structures having been returned, the flaps of meninges and skin are sutured separately and not in one line (p. 744). In some cases periosteal grafts or bones from freshly killed animals have been introduced with varying success.† Considering the tender age and feeble powers of these patients—infants, as a rule—it is certainly not worth while to prolong an operation, anæsthetic, &c., for this purpose. If, however, the patient is not an infant and the condition is good, and moreover if the gap in the spine is a large one, an attempt should be made to protect this by means of flaps of aponeurosis and muscle derived from the erector spinæ. Either one large flap may be raised and swung across so that the line of sutures is at the side, or two flaps may be used and united in such a manner that the line of sutures is not immediately beneath the skin sutures. The very lowest part of the meningeal and skin flaps may be left unsutured, but no drainage will be needed, and leakage is greatly to be deprecated. Iodoform gauze wrung out of carbolic acid lotion (1-20) having been placed on the wound, a sufficient thickness of salicylic wool is then applied, and bandaged with firm and even pressure. For the first few days the head should be kept low and the spine raised so as to prevent the tendency to leakage of cerebro-spinal fluid. A shield of silver, vulcanite, or thin sheet-lead should be worn later until the parts have thoroughly consolidated.

Causes of Failure after the Radical Cure of Spina Bifida.—1. Leakage and septic meningitis. 2. Convulsions and rapid death. Mr. Clutton, who brought a successful case of Dr. Morton's treatment before the Clinical Society (*Trans.*, vol. xvi. p. 34), mentioned another in which this treatment was immediately followed by fatal convulsions. The same proved fatal in about ten hours in a case under my care. Mr. Bennett, during the same discussion, mentioned a case in which, owing to the child being indisposed at the time, he declined to operate. On its way home the child died of convulsions. He remarked that if he had used the injection, this would have been credited with the convulsions. 3. Paraplegia. This setting in after injection may be temporary or permanent. 4. Hydrocephalus. This also may make its appearance after the injection with iodo-glycerine or excision, as happened in a case of my own three days after the latter operation. The nerves here were few and small and easily detached with the adjacent sac into the canal. 5. After tapping or injection the swelling may progress unaltered.

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* In those cases where there is a distinct peduncle, this, if hollow, must first be opened to inspect its interior. If it contain no structures of importance it is secured by running it round with a kangaroo-tendon ligature, and the sac beyond cut away.

† Dr. R. T. Hayes, of Rochester (N. Y.), introduced twenty grafts of periosteum from a freshly killed rabbit. Three months later the case was reported satisfactory, with a firm, hard, resistant covering. (*Med. Record*, June 16, 1883).

LAMINECTOMY.—RACHIOTOMY.—PARTIAL RESECTION OF THE VERTEBRÆ.*

This rare operation, which has of late been revived, must be referred to here under the following indications: A. *Cases of injury, i.e., Fractures and Dislocation.* B. *Penetrating wound of the canal.* C. *Cases of inflammatory disease—e.g., Pott's curvature.* D. *Cases of new growth.*

A. *Cases of Injury.*—Here the operation has been suggested by the analogous one performed on the skull, and the large amount of success which has followed it. But the analogy is, for several reasons, a deceptive one. Thus, owing to the small size of the cord, an injury which would only damage the brain slightly, almost inevitably destroys the structure of the cord throughout its thickness. Again, it must be remembered that a fragment of bone often inflicts injury upon the cord instantaneously, and that in a moment irremediable† damage may be done, though all deformity may be removed by raising and straightening the patient, and by the elasticity of the bones and the contraction of the muscles. Further, the cord may be most severely damaged, though its theca shows no sign of injury.

Again, when the surgeon trephines the skull, he not only hopes that the damage is slight and of a removable nature, but he also believes that the only damage to the bones is that which lies close to his trephine and finger. But in the case of the spine we are faced by this dilemma: If the fracture has been from direct violence, and the spinous processes and laminæ have been driven in, it is only too probable that when these are elevated the spinal cord, so limited in size, will be found too much damaged to profit by the operation. On the other hand, if the fracture has been caused by indirect violence, it is almost certain that the bodies of one or more vertebræ will have been crushed down, and a portion shot back into the canal.‡ In this case the fragment which has inflicted the injury, and which is keeping up the irritation, will be in front of the cord and out of reach, even if the cord were in a condition to be much benefited by its removal. A surgeon trephining the spine under these conditions would be like one who trephined the skull in order to remove depressed fragments of the vertex, when all the time a portion of the base of the skull was lying jammed into the under surface of the brain.

But it is not only in the damage, but in the violence of the fracture also that no analogy lies between the two cases. Fracture of the spine is usually due to indirect violence, as when the neck is broken by a fall on the head, or when the lower dorsal spine is fractured by a fall of a sack upon the shoulders. Even when the fracture is due to direct violence, it is of an entirely different nature to that for which the surgeon hopes to trephine successfully in the skull, and one far more likely to produce extensive and crushing damage—*e.g.*, the fall of coal or earth, or a fall from a height upon a projecting body.

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* Of these names the third is the only one which is correct and sufficient. It is, however, too long and cumbrous for general use in these days of hurry. Rachiotomy, which we owe to Mr. Davies-Colley, is very good as far as it goes, but insufficient. In this operation a good deal more is done to the vertebræ than merely cutting into them. Laminectomy, like appendicectomy, is objectionable from its hybrid derivation, but as, like the above term, it is explicit, convenient, and already in general use, it will be used here.

† Hence accounting for the very grave fatality of fractures of the spine, a fact held by some to justify trephining. The above account is taken from my article on "Injuries of the Back," *Syst. of Surg.*, vol. i. p. 673.

‡ This is a very common condition, judging from museum specimens. It is well illustrated by Figs. 93 and 94 in my article to which I have alluded above.

Finally, permanent compression of the cord—compression that can be removed, as can fragments of the skull—is a very rare event.* Even where permanent compression is present laminectomy will do very little. The surgeon may find it possible to restore the lumen of the vertebral canal, but the cord has been crushed as well as compressed. Mischief, usually hopeless mischief, has been done, for it has been proved by experiments and otherwise that a crushed cord is incapable of regeneration.

It remains to be shown that trephining the spine is not only likely to be void of any good results, but that it also involves serious risks and entails additional dangers of its own. Thus, the conversion of a simple into a compound fracture, the formation of a large, deep, and more or less ragged wound, the risk of subsequent suppuration with free access to the sheath of the cord, the opening up of cancellous tissue with its various channels and exposure of these to possible suppuration —all these have, I admit, been lessened by the use of antiseptic precautions. But the risk, though diminished, remains; the large amount of venous oozing tending to soak quickly through in this region can only be met by frequent dressing. And though it has been shown that in some of these cases the wound has healed quickly, and though no improvement has followed, the spinal column has not been fatally weakened by the removal of the laminæ and spines, yet the weakening for a time must be considerable; and it must be remembered that by the removal of these structures the mobility of the fractured parts will be much increased, and when any attempt is made to vary the position of the patient in bed, there will be, for some time, a risk of disturbing the fragments and thus of inflicting further injury on the cord.

It will be seen from the above that my own opinion is averse to any surgical interference in cases of fractured spine, owing to the amount of damage to the cord being usually, from the first, irreparable. To quote other writers: Mr. Thorburn (*Surgery of the Spinal Cord*, 1889, p. 160; *Brit. Med. Journ.*, 1894, vol. i. p. 1348) comes to the same conclusion, but draws an important distinction between the cord and its nerves. This writer thus sums up the question of operative interference in fractures and dislocations of the spinal column (*loc. supra cit.*): "In compound fractures, operate. In fractures of the spinous processes and laminæ, with injury to the cord, we also operate. In simple fractures and dislocations of the bodies of the vertebræ, if there is a reasonable probability that the injury is due to hæmorrhage,† operation is advisable, but in all other cases of this nature we cannot hope to do good save where the injury is below the level of the first lumbar vertebræ. In such cases laminectomy is an eminently valuable surgical procedure." Mr. Thorburn advocates surgical interference here on the following grounds: (1) "We may here expect a regeneration of the nerve roots, the physiological evidence being strongly in favour of such regeneration, and not against it, as in the case of the cord. (2) The absence of spontaneous recovery in such cases in itself indicates the presence of a mechanical obstacle, such as permanent compression by bone, blood-clot, or cicatrix, otherwise we should expect the roots of the cauda equina to recover, as other peripheral nerves after severe injuries." Dr. J. W. White (*Ann. of Surg.*, July, 1889) strongly advocates surgical interference in fractured spine, believing that fracture of the laminæ and spinous processes, and therefore relievable pressure on the cord, will not be found so rare as has been usually believed. I fear the weight of pathological evidence is all the other way. For my own part I should only be inclined to interfere where the following conditions are present: A history of a direct injury; mobility and displacement, laterally or downwards, of the spinous process; great local tenderness; the usual symptoms of swelling, &c.; and paraplegia less marked than usual.

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* J. Hutchinson, *Lond. Hosp. Rep.*; Thorburn, *loc. infra cit.* It will be noticed that permanent compression is a very different thing from irreparable injury. The latter is present, only too frequently.

† Mr. Thorburn thinks that the following would be the most advisable steps in these very rare cases: A laminectomy at the seat of injury, and an endeavour to arrest

B. *Penetrating Wounds of the Spinal Cord.*—Mr. Thorburn (*loc. supra cit.*) shows that while the percentage of recovery is good as to life, complete recovery of function is uncommon, owing to the little power of recovery of function after a destructive lesion of the spinal cord in man, especially in adults. He would also regard as useless the operation of suture of the pia mater as proposed by Chipault, and points out that it may be harmful not only by necessitating manipulation of the injured cord, but also by confining effused blood and serum, and thus increasing the pressure upon those parts which have escaped section. With the nerve roots, on the other hand, which are capable of repair, operation and suture would be quite justifiable.

C. *Cases of Inflammatory Disease—e.g., Pott's Curvature.**—Interference

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the hæmorrhage and to give exit to the blood; this procedure being combined in the first instance with paracentesis of the meninges in the lumbar region after Quincke's method (*vide infra*), and this failing, a secondary laminectomy at the lower part of the spine.

* Reference should be made, in addition to the writings quoted above, to the following: (1) In cases of injury, Macewen, *Brit. Med. Journ.*, 1888, vol. ii. p. 308; Keetley, *ibid.*, p. 421; Duncan, *Edin. Med. Journ.*, 1889, p. 830; E. Hart, a case of M. Péan's, *Brit. Med. Journ.* 1889, vol. i. p. 672; H. W. Allingham, *ibid*, p. 838; Chipault, *Gaz. des Hôp.; Arch. Gen. de Méd.*, 1890; *Rev. de Chir.*, 1890, 1891, and 1892; these careful and elaborate papers are now embodied in Chipault's work on the Surgery of the Nervous System; Schede of Hamburg, *Ann. of Surg.* 1892, vol. ii. p. 230; Wyeth, *ibid.*, August, 1894; Biddell, *Med. and Surg. Reporter*, March 30, 1895; Lejare, *Gaz. des Hôp.*, June 2, 1884; Arnison, *ibid.*, May, 1895. (2) In cases of Pott's curvatures, Macewen and Duncan (*loc. supra cit.*); Wright, *Lancet*, July 14, 1888; W. A. Lane, *Brit. Med. Journ.*, April 20, 1889; *Lancet*, July 5, 1890; Abbe, *New York Med. Journ.*, Nov. 24, 1888; Kraske, *Centr. f. Chir.*, 1890, Heft 25; Dr. S. Lloyd, of New York, *Ann. of Surg.*, 1892, vol. ii. p. 289; Bullard and Burrell, *Trans. Med. Orthop. Assoc.* vol. ii. p. 241. Several of the above cases have been reported so soon after the operation that their value would be much increased by the authors giving later details. (3) In cases of

here will be but very rarely called for. For, on the one hand, the pathology of these cases makes them much more hopeful than in fracture, the paralysis here being due, not to pressure of displaced vertebræ, or to irremediable damage of the cord—*e.g.*, myelitis, degeneration—but to the results of a chronic, localised, external pachymeningitis, producing pressure by a mass of scar-like connective tissue. On the other hand, we have abundant evidence that paralysis, even when of long duration, has a marked tendency to recovery, if the treatment by absolute rest in the recumbent position is vigorously enforced, and if potassium iodide is pushed in large and frequent doses, after the American method.*

Mr. Thorburn (*loc. supra cit.*) gives the following **indications** and **contra-indications** for operation. **Indications**: (1) "Assuming the prognosis to be thus favourable, we are never called upon to perform laminectomy save under certain special conditions. It will not be argued that the recovery after laminectomy is more complete than that produced by Nature, and experience shows that relapses also are only too common after operation. The indications which appear to me to point to the necessity for operations are then as follows: A steady increase in symptoms in spite of favourable conditions and treatment. The presence of symptoms which directly threaten life. Thus, in my second case, the secondary chest troubles were very grave.† Intractable cystitis would fall into this category, but it is by no means common, and we can hardly agree with those who hold that the condition is in itself incapable of spontaneous recovery.

"The persistence of symptoms in spite of complete rest,‡ is the indication which has been most commonly adopted, but, as we have already seen, such symptoms may persist for very long periods and then yield to absolute rest. It is, however, not improbable that, in a few cases, cicatricial pachymeningitis, or rather peri-pachymeningitis, may remain after the original pressure-lesion has ceased to act, and may thus keep up paraplegia until the constricting tissue is removed.

"4. In posterior caries (that is, in caries of the arches of the vertebræ) operation is clearly indicated, as here we can readily both treat the

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new growths, Dr. Gowers and Mr. Horsley's paper (*loc. supra cit.*) and the appended table. See also Dr. J. W. White's paper (*loc. supra cit.*), and his table of the most obvious diagnostic points, p. 32; Starr, "Tumour of the Spinal Cord," *Amer. Journ. Med. Soc.* June, 1895; and Patnam and Collins Warren (*Amer. Journ. of Med. Sci.*, Oct. 1899).

* In an adult gr. x–xx is given every half-hour, if possible, in a large glass of milk.

† Dr. Parkin, of Hull, in a valuable paper (*Brit. Med. Journ.*, 1894, vol. ii. p. 700) illustrated by cases of laminectomy for spinal caries, mentions a case aged 9, admitted for cervical caries, cyanosis and bronchitis. As the condition became more critical, the sixth cervical spine was removed. The cord was found compressed and bent by a mass of bone and fibrous tissue, the remains of the fourth and fifth vertebræ. When the cord was freed, pulsation returned. Very great benefit followed on the operation, but the child died nearly three months after of tubercular meningitis, thought to be due to a caseating gland found at the necropsy. No evidence of caseation or recent caries was found in the vertebræ.

‡ Readers with careful and well-balanced minds will not fail to note on reading the accounts of many of these cases, published as successful cases of laminectomy for spinal caries, that many of them before being submitted to operation, had only been treated by rest for a few days or weeks, "the mother having full directions to keep the child in the same horizontal posture." In other cases, after a brief period of in-patient treatment, the children have been sent out in Sayre's jackets to attend as out-patients.

paraplegia and remove the whole of the tuberculous tissue. Two cases of this nature are recorded by Abbe and by Chipault respectively, and both proved highly successful.

"5. In my fifth case, the existence of severe pain, which was rapidly exhausting the patient, was regarded as an indication for surgical interference.

"6. Lastly, children as a rule yield better results than do adults, so that, other things being equal, childhood may also be regarded as an indication for operation.

"**Contra-indications.**—The presence of active tuberculous changes in other organs. Macewen holds that we should not operate when there is pyrexia, which is almost tantamount to saying that we should not operate in presence of active tuberculosis. If, however, the pyrexia were clearly due to cystitis, then we might regard it as an indication for, rather than against, interference. Again, general meningitis (although fortunately very rare) will at times obviously be present and will probably prove fatal whether we operate or not."

D. *Cases of New Growth.*—Mr. Horsley has here, as in so many other instances connected with the surgery of the central nervous system, operated with brilliant success (*Med.-Chir. Soc.*, vol. lxxi. p. 383).

The patient was one of Dr. Gowers', aged 42, and his chief symptoms were complete paralysis of the lower limbs and abdomen, the former being frequently flexed in clonic spasms, the pain accompanying these being extremely severe. There was loss of tactile sensibility as high as, and involving the distribution of, the fifth dorsal nerve. The bladder and rectum were completely paralysed. The growth proved to be an almond-shaped fibro-myxoma resting on the left lateral column, in which it had formed a deep bed, and adherent to the fourth dorsal nerve. The patient recovered perfectly, the report being continued up to a year after the operation.

A great deal of useful information may be obtained from a paper on this subject by Messrs. Putnam and Warren (*Amer. Journ. of Med. Sci.*, Oct., 1899). The authors give a *résumé* of thirty-three cases of spinal tumour treated by operation. Of these operations "seven led to recovery and ten to more or less improvement, although only in five of these latter, amongst which our first case was included, was the improvement considerable or lasting."

On the other hand, fifteen of the operations were fatal, so that the mortality has been nearly 50 per cent., a fact not to be lost sight of when this operation is contemplated.

Operation.—The patient being placed as far as is safe in the prone position, and the skin rendered scrupulously clean, an incision is made down to the spinous processes, with its centre opposite the point of the angle of curvature, the site of the supposed displacement or disease. The deep fascia having been divided along the spines and also transversely at the upper and lower angles of the wound, the tendinous attachments of the muscles are cut from the spine, and the muscles completely detached from these processes, the laminæ, and from the transverse processes as far as is necessary, by the edge of a short, stout scalpel. To prevent hæmorrhage, Spencer Wells's forceps are quickly applied, and then sponges are tightly packed into the incision on one side of the spine, while the operation is proceeded with on the other. Efficient compression will usually suffice. Any vessels that require it being tied, and the muscles held back with retractors, the periosteum is reflected with a suitably curved elevator. Two or three spinous processes, if unfractured, are then cut off close to their bases with powerful bone-forceps with jaws at different angles. The laminæ may be next removed by spinal saws, aided by a trephine, but the most speedy method is by using Mr. Horsley's bone-forceps devised for working at the bottom of a deep, steep wound-cavity.* A chisel and mallet may be used along an already made saw line, to complete the section; but even here the vibrations may be hurtful. Where the arches and the dura may be adherent, the bone must be removed with great caution; "picked away piecemeal," Tubby (*Orthop. Surg.*, p. 74). In the case of fracture, any loose bone will of course be tested and removed by sequestrum-forceps. The ligamenta subflava are next cut through with a sharp knife. The dura mater, covered with peculiar vascular fat, is next exposed. To avoid troublesome hæmorrhage from the numerous veins of this tissue, it must be opened strictly in the middle line and then kept with broad retractors pressed against the sides of the spinal canal, while the dura mater is opened (Horsley). This being done with knife and dissecting-forceps in the middle line, the cerebro-spinal fluid escapes freely, and should be mopped out with sponges as long as it flows. If the patient is kept quiet, and the spine horizontal, and the head not raised, this flow will soon cease (Horsley). Any growth is then removed, and the cord inspected and palpated very freely, so as to reveal any change in its density. If it be suspected that a fragment of bone or a new growth be pressing against the front of the cord from one of the vertebræ, Mr. Horsley advises that the sides and anterior aspect of the cord be explored by the careful passage of an aneurysm-needle. Where the dura mater has been opened for exploratory purposes only, it should be sutured with fine catgut, one end being left open. If any growth has been removed from within, it will probably be wiser to provide for drainage of the sub-dural space with horsehair. The extra-dural space should be drained with a small tube.

In cases of caries, dense scar tissue, granulation tissue, pus, or a tubercular mass may present themselves when the dura mater is exposed. In some it will be sufficient to take away the diseased material, till pulsation of the cord reappears; in others the tougher leathery substance must be snipped away with scissors till the cord is exposed with a surface made as smooth as possible, and it is clear that, if not pulsating, it is not constricted. Any carious bone that is within reach will of course be removed by the sharp spoon. If, as is not unlikely, the mischief—*e.g.*, tubercular caries, abscess and granulation tissue—lie in front, this must be got at, if possible, by drawing the cord from side to side with an aneurysm-needle, cautious removal of part of the transverse processes and adjacent bones. When all diseased bone, granulation tissue, &c., has been removed with the sharp spoon, a small flushing gouge (Fig. 237), or gauze mops, iodoform emulsion may be applied, and the greater part of the wound closed; drainage either by means of a tube or iodoform gauze should, however, be provided for twenty-four or forty-eight hours, as oozing may possibly be considerable.

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* The surgeon should take the trouble to be provided with the necessary instr ments. The ordinary saws and forceps are quite unfitted for removing the lami and, in the case of the cervical spine, may, by prolonging the operation and pres on the cord, bring about a fatal result.

The dura mater is only to be opened when the state of the cord itself must be investigated, when sufficient mischief is not found outside, or when an intra-dural growth exists. This step is especially to be avoided in tubercular cases, as it may cause a tubercular meningitis (Chipault).

Causes of Failure and Death after Laminectomy, &c.—(1) Shock. As I have already stated, the failure of the surgeon to supply himself with proper instruments may lead to needless prolongation of the operation and pressure on the theca which, especially in operations on the cervical region, may help to bring about a fatal result. (2) Hæmorrhage. This seems to have been rarely troublesome; the extra-dural plexus appears to be usually obliterated in cases of Pott's curvature. According to Chipault hæmorrhage has no special interest in the lumbar and dorsal regions, in the neck it is much more serious, since death has resulted three times from a lesion of the vertebral artery. (3) Respiratory trouble, probably largely due to the prolonged anæsthetic. In one case (Deaver, *Inter. Journ. Med. Sci.*, Dec., 1888) the respiration became much embarrassed towards the end of the operation; this continuing till the patient's death three days later, was attributed to injury to the phrenic nerve with an exploring needle. The dura mater, thickened and adherent to the base, had been thus explored after removal of the third and fourth cervical arches which were carious. (4) Septic complications. (5) Tubercular or other secondary deposits elsewhere. (6) Temporary improvement followed by a relapse.

TAPPING THE SPINAL THECA.

This step was advised by Quincke as a means of relieving pressure symptoms in acute and chronic hydrocephalus, and also to aid in the diagnosis between serous, purulent and tubercular* meningitis. The interval between the third and fourth lumbar spines is taken, and the theca is found at a depth of four centimetres. Albertin (*Lyon. Méd.*, October 8, 1899) reports a most interesting case, which serves to illustrate the usefulness of this measure in relieving intra-spinal pressure in certain cases:—

A man fell from a window, striking his knees and then his back. Paraplegia was the immediate result, the reflexes were absent, and there were large areas of cutaneous anæsthesia. The sphincters were, however, unaffected. Fourteen days later Albertin inserted a trocar into the spinal canal in the lumbar region, and drew off one ounce of blood-stained fluid. Forty-eight hours later the reflexes had returned, and from this time slow improvement took place, so that two weeks later the patient could walk with crutches. The final result is not given.

Spinal Anæsthesia.—Since Dr. Leonard Corning, of New York, discovered this method of inducing anæsthesia in 1885, it has been given an extended trial, and a large number of cases have been recorded, so far according to Drs. William White and F. D. Patterson (*Amer. Journ. of Med. Sci.*, 1901, p. 227†), without a single death due to the anæsthetic. Sequén and Kendirdjy (*Presse Méd.*, Oct. 27, 1900) report fifty-seven cases, in all but two of which the anæsthesia was perfect. Tuffier (*Presse Méd.*, Nov. 7, 1900) reports 210 successful cases, 112 of which were intra-peritonæal operations.

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* Fürbringer found tubercle bacilli in twenty-seven out of thirty-seven cases of tubercular meningitis, one of which is stated to have ended in recovery (*Berlin Clin. Woch.*, Nov. 13, 1893).

† Where a useful account is given, and from which most of what follows has been drawn.

Complete anæsthesia below the level of the umbilicus is produced in from four to ten minutes after the injection, and lasts for an hour to an hour and a half. As regards after-effects, vomiting is frequent, also severe headache; in a few cases also transient paraplegia and retention of urine have occurred. The greatest objection to the employment of the method is undoubtedly the very grave danger of sepsis, and it is the fear of this which will probably prevent any general adoption of the plan. The question of safety apart from sepsis is, moreover, certainly not settled at present. Drs. White and Patterson (*loc. supra cit.*) say: "In conclusion, it may be said that although no deaths have so far been reported from this method, it still remains to be shown that subarachnoid cocainisation is safer than general anæsthesia; in fact, it is very questionable if it is as safe. The puncture of the spinal canal itself, not to mention the injection of cocaine, is not without its danger, as has been shown by Gumprecht (*Deutsche Med. Woch.*, 1900, vol. xxvi. p. 386), who reports seventeen cases of sudden death following simple lumbar puncture for diagnostic purposes."

Operation.—The greatest care must be exercised to maintain asepsis. The patient's skin must be carefully prepared beforehand, and the surgeon's hands cleansed as for a major operation. The instruments and cocaine or eucaine solution must also be sterile. Mr. Priestley Leech (*Med. Annual*, 1901) describes the technique as follows:—The patient is laid on one side, say on the left side, he is told to round his back, flexing the legs on the thighs and the thighs on the abdomen, and a cushion is placed underneath his flank. In this way, the spinous processes of the vertebræ are separated to the greatest extent, the space between being one and a half centimetres (nine-sixteenths of an inch). The lumbar region is then cleansed. The surgeon then feels the posterior inferior iliac spines situated below the great sciatic notch; he joins the spines by a transverse line which passes at the level of the fifth lumbar vertebra; it is below this line he will look for the sacro-lumbar fossa, and from this point count the lumbar spinous processes till he reaches the third or fourth lumbar interspace, which is the seat of election. When the seat of election has been determined, it is marked with tincture of iodine, and the skin is rendered anæsthetic by means of ethyl chloride; this prevents any involuntary movement which would bring the processes together. The needle should be strong, three and a quarter inches to four inches in length; in thin young children an ordinary hypodermic-needle suffices, but, as a rule, it is too short and fragile.

The surgeon now finds the spinous process corresponding to the space selected (the third or fourth lumbar space); keeping his finger on the spinous process he now inserts the needle half a centimetre to its outer side to the right or left of the middle line as the case may be. The needle is held between the thumb and index finger of the right hand, and pushed without violence from behind forwards, from without inwards and from below upwards; these directions must not be exaggerated; the obliquity of the needle upwards and inwards must be very slight. The needle may be arrested by something resistant, *i.e.*. one of the two bony laminæ, and it is nearly always the superior lamina of the space the surgeon wishes to traverse. The needle must be withdrawn a little, and pushed in another direction. When the surgeon has traversed the inter-laminar space he must watch the external orifice of the needle, as a drop of cerebro-spinal fluid wells up as soon as the sub-arachnoid space has been reached. The escape of cerebro-spinal fluid is the sign, without which cocaine must never be injected. When eight or ten drops of cerebro-spinal fluid have welled up through the needle, the time has come to inject the cocaine. . . . The injection must be made very slowly, the solution must be freshly prepared, the temperature of the solution must be about 37° C., and the quantity of cocaine injected must never exceed four centigrammes. The solution must be a weak one, either 1 in 100, or 1 in 200; eight cubic centimetres of a 1 in 200 solution would represent four centigrammes of cocaine.

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